STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
GEORGE D. NORDENHOLT, Director

DIVISION OF MINES

WALTER W. BRADLEY
State Mineralogist

GEOLOGIC BRANCH
Ferry Building, San Francisco

OLAF P. JENKINS
Chief Geologist

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MINERALS OF CALIFORNIA

By
ADOLF PABST
Associate Professor of Mineralogy
University of California
BERKELEY

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LETTER OF TRANSMITTAL

To His Excellency, the HONORABLE FRANK F. MERRIAM,
Governor of California.

SIR:

I have the honor to transmit herewith Bulletin No. 113 of the Division of Mines of the Department of Natural Resources, on the "Minerals of California."

California is known the world over for the remarkable number and diversity of her mineral substances that are annually produced and utilized for commercial and other beneficial purposes. She is equally well known among scientists, mineralogists, teachers, and plain-citizen hobby collectors of minerals as a most fertile field for the study and collection of a long and varied list of mineral species. In fact, many new and rare species have first been found and described from Californian localities.

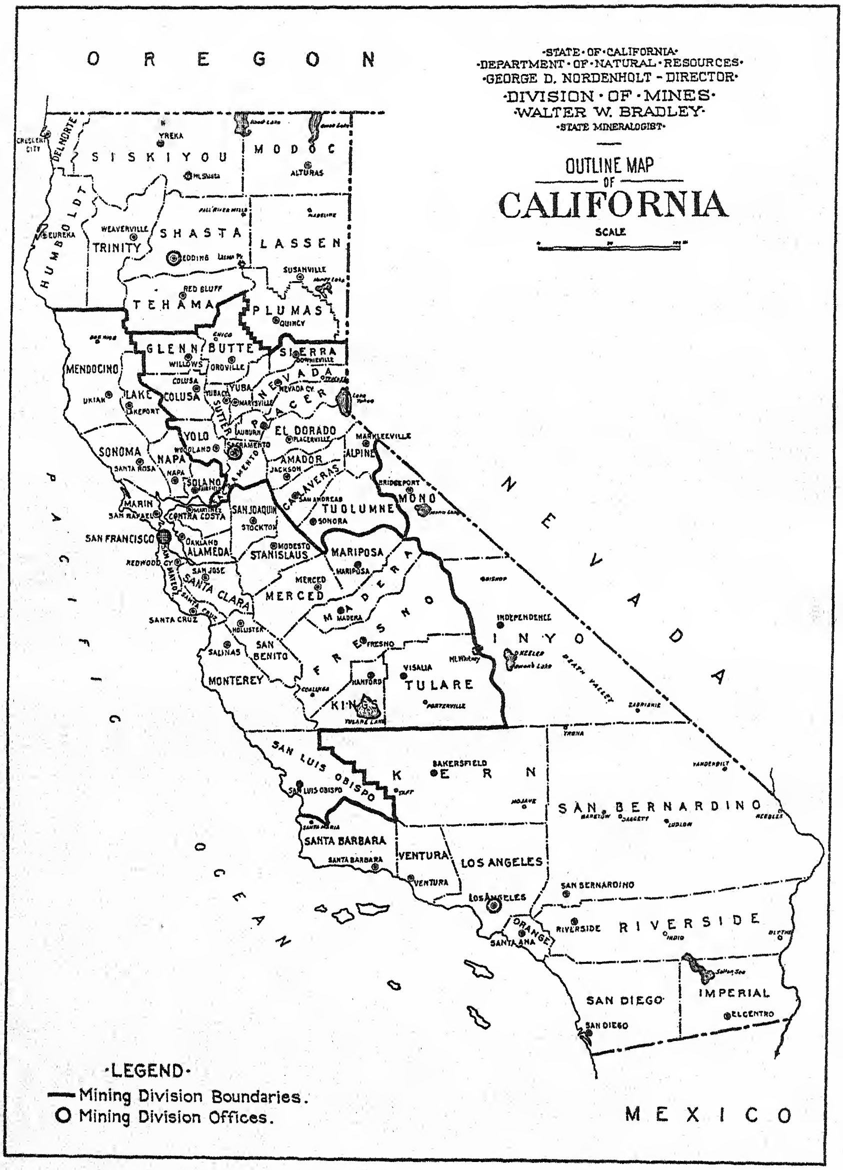
There is a growing interest among all classes of people of this State in the study of minerals. To have a record of the 'what' and 'where' is an important starting point to a knowledge of the mineral resources of possible commercial value. Previous editions of the "Minerals of California" have long since been exhausted, and the present work has been one of the items in the program of coordinated study and survey conducted by the Division of Mines to make available to the public a record of California's resources.

The assembling and preparation of the text has been done by Dr. Adolf Pabst, Associate Professor of Mineralogy, University of California, who also supervised the gathering of new data and revisions in cooperation with Dr. Olaf P. Jenkins, Chief Geologist of the Division of Mines, and with clerical assistance furnished by the Federal Works Progress Administration. Many contributions have been received from various individuals and organizations cooperating to make this bulletin an outstanding piece of work, complete, and up to date.

Respectfully submitted.

GEORGE D. NORDENHOLT, Director,
Department of Natural Resources.

November 1, 1937.



·STATE·OF·CALIFORNIA·
·DEPARTMENT·OF·NATURAL·RESOURCES·
·GEORGE D. NORDENHOLT - DIRECTOR·
·DIVISION·OF·MINES·
·WALTER W. BRADLEY·
·STATE MINERALOGIST·
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PREFACE

The first list of California minerals was published by W. P. Blake in 1866, and it comprised about seventy-five mineral species. At that early time California was a new and largely unexplored field, and only a few scattered localities were known for mineral specimens; consequently, the list was short and not at all representative.

The second list appeared in 1884 as a part of the Fourth Annual Report of the State Mining Bureau, by Henry G. Hanks, who was then State Mineralogist. This list included double the number of previously known minerals, and gave detailed descriptions of some of the localities, and much instructive matter relating to minerals of economic value.

The third list compiled by Dr. A. S. Eakle, was issued in 1914 as Bulletin 67, "Minerals of California," of the California State Mining Bureau. In the thirty years which had elapsed since the appearance of the second list, knowledge of the geology and mineralogy of the State greatly increased. The ore deposits of many of the counties, the gem and borate deposits of the southern counties, and the petrography of many districts, had been investigated and described, so that the third list contained more than double the number of definite mineral species given by Hanks, besides many subspecies and varieties.

In 1923 a second edition of "Minerals of California" was published as Bulletin 91 of the California State Mining Bureau. Many additional species were included, and the list of localities in which some of the more common economic minerals occur was greatly increased.

The present bulletin is a further revision. Many occurrences described in the literature since the second edition have been included, and some material has been obtained from other sources. All of the older literature on the occurrence of minerals in California has been rechecked to eliminate errors. The number of citations to literature both before and after the date of the last edition has been greatly increased. Even with these changes, much material for which no good authority can be given has been retained in the new bulletin.

Over 400 different minerals, not including varieties, are described in this bulletin. Of these 54 were discovered in California, including several that have proved to be of great importance. Colemanite, discovered in 1882, and kernite, discovered in 1827, are without

doubt the most important commercial borates. Lawsonite, first found in Marin county in 1895, has proved to be of great petrographic interest. The first new minerals discovered in California came from the gold mining region of the Sierra Nevada, beginning with the nickel telluride, melonite, found in Calaveras County in 1867. New minerals and new mineral localities are still being discovered so that such a catalogue as this is necessarily incomplete. Many minerals are so commonly distributed throughout the State in small bodies or as rock-forming minerals that it would be impossible to cite all of their occurrences.

The minerals first found in California and the dates of their published descriptions are as follows:

*Partzite, 1867
Melonite, 1867
*Mariposite, 1868
Calaverite, 1868
Metacinnabar, 1870
*Aragotite, 1873
Roscoelite, 1875
*Posepnyte, 1877
*Ionite, 1878
*Tincalconite, 1878
Colemanite, 1883
*Hanksite, 1884
*Napalite, 1888
Sulphohalite, 1888
*Knoxvillite, 1890
*Redingtonite, 1890
Iddingsite, 1893
Lawsonite, 1895
*Northupite, 1895
Pirssonite, 1896
*Bakerite, 1903
*Boothite, 1903
*Tychite, 1905
*Benitoite, 1907
*Joaquinite, 1909
*Palaite, 1912
*Salmonsite, 1912
*Sicklerite, 1912
*Stewartite, 1912
Inyoite, 1914
*Meyerhofferite, 1914
Searlesite, 1914
*Wilkeite, 1914
*Crestmoreite, 1917
*Griffithite, 1917
*Riversideite, 1917
*Plazolite, 1920
*Vonsenite, 1920
*Jurupaite, 1921
Merwinite, 1921
*Kempite, 1924
*Foshagite, 1925
*Kernite, 1927
*Probertite, 1929
*Curtisite, 1930
Krausite, 1931
*Sanbornite, 1931
*Schairerite, 1931
*Tilleyite, 1933
*Burkeite, 1935
*Woodhouseite, 1937
*Ellestadite, 1937
*Teepleite, 1938
*Veatchite, 1938

So many minerals and localities are included in the list that geological and petrographical descriptions in detail have had to be omitted, and reference must be made to the bibliography at the end of the work under the author's name and number. This bibliography includes, with few exceptions, only those articles which deal directly with minerals of the State, omitting the literature of a general nature on the geology and mining industry of California. For this, reference should be made to Bulletin 104, "Bibliography of the Geology and Mineral Resources of California to December 31, 1930", of the Division of Mines, and also to Bulletin 115, a forthcoming bibliography for the years 1931 to 1936, inclusive.

The work of preparing this revision has been carried on in part with the aid of a Federal Works Progress Administration project. Many mineral collectors and mineralogists have also contributed material for the revision. Two assistants, Mr. George L. Gary and Miss Alice Gilbertson have helped me faithfully throughout. Mr. Gary has done a large part of the work on the literature and has prepared the new bibliography. The writer is also greatly indebted to Mr. Walter W.

* Minerals not yet been found, so far as known, outside of the State of California.

Bradley and Dr. Olaf P. Jenkins of the State Division of Mines, Dr. Ian Campbell, of the California Institute of Technology, to Professor Austin F. Rogers of Stanford University, Mr. M. Vonsen of Petaluma, Mr. John Melhase of Berkeley, Professor A. O. Woodford of Claremont, California, Dr. W. T. Schaller of the United States Geological Survey, and to Dr. W. F. Foshag of the United States National Museum, all of whom have given much valuable advice and information.

Adolf Pabst.

Berkeley, California, January, 1938.

INTRODUCTION

In Dana's "Textbook of Mineralogy," a mineral is defined as a body produced by the processes of inorganic nature, usually having a definite chemical composition and, if formed under favorable conditions, a certain characteristic crystal structure which is expressed in its form and other properties.

Practically all of the inorganic part of the earth's crust is made up of what we would ordinarily call minerals. These minerals occur together in various combinations and are associated in larger masses or bodies, some of great extent, which we usually call rocks. Rocks are the aggregates. Minerals are the individual components, often easily recognizable with the unaided eye. Rocks are usually classified broadly according to their origin. There are three principal groups: Igneous, sedimentary, and metamorphic.

Igneous rocks are formed by the cooling of molten material. Examples of the formation of igneous rocks are familiar to all, in the cooling of lava emitted by active volcanoes. Such rocks cover great parts of the earth and are widely distributed in California.

Not all igneous rocks have formed at the surface. Some have formed by the cooling and consolidation of molten masses beneath the surface. In the main, the granular igneous rocks such as granite have formed in this fashion. They are spoken of as intrusive rocks. Granitic rocks also occur in California making up a large part of the Sierra Nevada and of several other ranges.

Sedimentary rocks are mostly formed by the deposition of fragmental materials of either inorganic origin, such as gravels, sands and clays, or of organic origin, such as shells and other parts of animals and plants.

Some sedimentary rocks have formed by chemical precipitation either from the ocean or from the waters of salt lakes. The principal kinds of sedimentary rocks are sandstone, shale, and limestone. They are often characterized by a bedded or laminated appearance, and sometimes carry recognizable remains of plants or animals.

Metamorphic rocks are formed by physical or chemical changes in igneous or sedimentary rocks. Some of them greatly resemble certain igneous rocks.

Most common rocks are simple in composition, that is, they consist of only a few minerals. The granitic and related rocks are composed chiefly of feldspar and quartz with some mica and hornblende. The

other common igneous rocks are made up of these same minerals in varying proportions; some of them may also contain other minerals, especially pyroxene and olivine, in considerable amounts.

Sedimentary rocks may be composed of the same minerals as igneous rocks. Some of them are largely made up of the minerals most resistant to chemical and physical disintegration, as for instance, sandstones composed almost entirely of quartz. Other sediments may be composed of minerals formed by the alteration of pre-existing rocks. Clay in some cases consists chiefly of kaolin, which may form from the alteration of feldspars. Limestone consists very largely of calcite.

Metamorphic rocks may consist principally of the same minerals as the rocks from which they were formed, but in some cases new minerals are characteristic constituents of the metamorphic rocks. Schist and gneiss may be rich in chlorite and mica. Garnet is a conspicuous constituent of some metamorphic rocks, and in the Coast Ranges of California there are patches of metamorphic rocks that consist largely of glaucophane, actinolite, and related minerals.

Some interesting or important mineral deposits can not be classified as belonging to any of these principal groups of rocks. A great many mineral deposits occur as veins or segregations in other rocks.

A vein is a mineral deposit usually formed by the filling of a crack, and occurring as a more or less sheetlike body enclosed in other rocks. Some igneous rocks also occur in sheetlike forms. They are called dikes if they cut across the structures of the enclosing rocks, or sills if they parallel the bedding of the enclosing rocks. In spite of this similarity between dikes and veins, it is usually easy to distinguish them by their mineral composition, and also by their structure. Veins more frequently contain open cavities lined with crystals, or they may be banded, showing the gradual filling of a crack. Many important ore deposits occur as veins, and numerous minerals described in this book have been found in such deposits.

Pegmatite dikes, or pegmatites, are rocks that usually resemble granite in composition but which are coarse-grained veinlike irregular masses, and often contain some of the rarer minerals in large crystals. Pegmatites are found associated with granites in many parts of California, and have been the source of a number of commercial products. The gem-bearing pegmatites of San Diego County have aroused special interest.

Many minerals are formed by the alteration of previously existing minerals. Such alterations are especially common near the surface, as in the upper parts of ore deposits. It is customary to speak of the original constituents of a deposit as the primary minerals, and those which have formed later by alteration, as the secondary minerals.

Occasionally one mineral will so replace another as to retain the shape of the original. It is then said to be a *pseudomorph.* For instance, pyrite may be completely changed to limonite, exactly filling the space originally occupied by the pyrite. The limonite will then show the crystal form of pyrite.

In this bulletin a brief description is given of each mineral preceding the list of its occurrences in California. Those minerals which occur in good crystals are best characterized by their *crystal symmetry* and forms. The crystal symmetry is stated where known, and the forms of crystals that have been described from Californian localities are mentioned. It is impracticable in a bulletin of this sort to explain all of the terms and symbols used to describe crystals. A full discussion of this subject can be found in Dana's "Textbook of Mineralogy," fourth edition, 1932, or Rogers' "Introduction to the Study of Minerals," third edition, 1937.

Optical properties have not been given because they are useful only to those trained in microscopy. Information on the optical properties of most of the minerals mentioned in this book can be found either in the "Microscopic Determination of the Non-opaque Minerals" by E. S. Larsen and Harry Berman, Bulletin 848, or in "Microscopic Determination of the Ore Minerals" by M. N. Short, Bulletin 825, of the United States Geological Survey.

Many crystallized minerals show the property of *cleavage.* Cleavage is the tendency of a crystal to break with particular ease in the direction of certain planes. Many minerals show a characteristic cleavage, and this may be a feature by which they can be easily recognized. Cleavage is best described in crystallographic terms for which reference must also be made to the books just mentioned.

Streak is the color of the powdered mineral obtained when a specimen is rubbed on a streak plate, a piece of unglazed porcelain.

Luster is the appearance of the mineral surface, or the manner in which it reflects light. It is described by such terms as: adamantine, gemlike; resinous, like resin; vitreous, like glass.

The *hardness* of minerals is stated in terms of the so-called 'scale of hardness.' Ten minerals have been chosen as standards of hardness, and their hardness has been designated by numbers. Numerical values are then given for the hardness of other minerals by which they can be compared with the standard. The scale of hardness is:

1. Talc
2. Gypsum
3. Calcite
4. Fluorite
5. Apatite
6. Orthoclase
7. Quartz
8. Topaz
9. Corundum
10. Diamond

Many minerals tend to occur with a characteristic mode of aggregation, or arrangement of the grains or crystals. This is referred to as the habit or structure of the mineral. Terms in use to describe such mineral structures are explained in the glossary.

A few characteristic chemical reactions of the minerals, and their behavior before the blowpipe, are also given in the text. To some extent it will be possible to identify minerals from the descriptions given in this book, but minerals are best identified with the aid of tables especially prepared for the purpose. Such tables will be found in Rogers' "Introduction to the Study of Minerals" or in Brush and Penfield's "Determinative Mineralogy and Blowpipe Analysis."

NATIVE ELEMENTS

Non-metals	*Semi-metals*	*Metals*	
Diamond	Arsenic	Gold	Mercury
Graphite	Tellurium	Gold amalgam	Lead
Sulphur	Antimony	Electrum	Platinum
	Bismuth	Bismuth gold	Platiniridium
		Silver	Iridosmine
		Copper	Iron
			Awaruite

NON-METALS

DIAMOND

Native carbon, C.

Isometric. Octahedrons and hexoctahedrons common. Crystal faces often curved. Perfect octahedral cleavage. Brittle. Adamantine to greasy. Yellow and colorless crystals common. Red, orange, green, blue, brown, and black are rarer shades. H. = 10. G. = 3.5.

Unaffected by heat except at very high temperatures. Not acted on by acids or alkalies.

The extreme hardness and brilliant adamantine luster serve to distinguish diamond from quartz and other glassy minerals.

Bort is a hard rounded form without distinct cleavage. Unsuitable for gems.

Carbonado is a hard black variety without cleavage.

Diamonds were found in California soon after placer mining began. As early as 1849, Lyman (49) reported seeing a straw-yellow crystal about the size of a small pea, which came from one of the placers. A few years later they were observed in the gold gravels at Cherokee, Butte County, and this locality has become the most noted one in the State for the number found.

Placer deposits elsewhere have also yielded them from time to time, so their occurrence has not been limited to any one field. No record has been kept of the total number found, but it is probably between four and five hundred. Since all of them are chance finds, there can be no doubt that many more have been overlooked or destroyed.

A few of the stones found are over 2 carats in weight and of good quality, but the majority are small and mostly 'off color,' usually with a pale-yellow tinge. Most of these diamonds, now in the possession of different individuals, were found during the days when placer mining and hydraulicking were at their height, and since that time diamond finds have been less frequent.

In California, diamonds have only been found in placer gravels and in the black sands and concentrates of placer mines. Presumably their origin has been in the basic igneous rocks from which the ser-

pentines of the gold regions have been derived. The discovery near Oroville of an apparent pipe of serpentinized rock bearing a resemblance to the diamond pipes of South Africa led to some active operations on the part of the United States Diamond Mining Company, and a shaft was sunk, which proved not successful. The rock is a hard eclogite differing in its character from the kimberlite of South Africa. Hanks (84) gives an interesting account of the diamonds found during the early days of gold mining, and Turner (99) and Storms (17) contribute short articles on California diamonds.

Amador County: A few small stones have been picked up near the towns of Volcano, Oleta and Fiddletown, Silliman (67b); and, more recently, one of 2½ carats near Plymouth.

Butte County: In 1853 it was observed that diamonds occurred in the gravels at Cherokee Flat, about 9 miles north of Oroville, Silliman (67b). More than three hundred good diamonds have been obtained from the placers in this district, and it leads all the other districts in the State. It seems quite probable that the source of these diamonds is not far from this locality. Silliman (73), (73b) gave the contents of the black sands at Cherokee as platinum, iridosmine, gold, pyrite, chromite, magnetite, limonite, diamond, quartz, rutile, almandite garnet, topaz, zircon and epidote. A diamond weighing 2¼ carats was found at this locality. Found at Morris Ravine and Yankee Hill, W. W. Bradley (28). Some have also been found in the placers at Thompson Flat, 2 miles north of Oroville.

El Dorado County: A diamond weighing 1¼ carats was found at Forest Hill, Silliman (67b). About sixty have been found near Placerville, on Webber Creek, in White Rock Canyon and at Smith's Flat.

Fresno County: Small diamonds are reported to have been found a few miles north of Coalinga.

Nevada County: A 1½ carat stone was found at French Corral, Silliman (67b). The largest diamond recorded from California, 7¼ carats, was from Nevada County, Kunz (05).

Plumas County: Diamonds were found at Gopher Hill and Upper Spanish Creek, W. W. Bradley (28).

Siskiyou County: Diamonds occur in the placer gravels at Hamburg Bar.

Trinity County: Microscopic examinations of the black sands of the Trinity River and some of its tributaries have shown the presence of small diamonds as a constituent of these sands.

GRAPHITE—Plumbago—Black Lead

Native carbon, C.

Hexagonal-rhombohedral. In six-sided tabular crystals. Commonly in embedded foliated masses, also columnar or radiated; scaly or slaty; granular to compact; earthy. Cleavage; basal, perfect. Thin laminae flexible, inelastic. Feel greasy. Luster metallic, sometimes dull, earthy. Iron-black to dark steel-gray. Streak gray. H. = 1 — 2. G. = 2.09 — 2.23.

B. B. infusible. Unaltered by acids.

Graphite is prominent in some schists and gneisses and when present in considerable amount the graphitic gneiss or schist is sometimes mined for the graphite. In mining districts it is often seen coating the walls of veins and mixed with the talcose gouge.

It is a common constituent of crystalline limestones and is often disseminated through the limestone in minute flakes and in larger foliated masses.

No extensive deposits of good quality graphite are known to occur in the State, but a few small deposits have been worked for the manufacture of paints and lubricants. Much of the graphite of California is so intimately mixed with silica that its separation as pure material is an expensive operation. It is typically a constituent of metamorphic rocks and as such may be found in every county.

Amador County: Graphite occurs in considerable amounts in the wall rock at the Argonaut mine, Josephson (32).

Calaveras County: It is found in the copper-bearing schists. Specimens have come from Copperopolis and Campo Seco.

Del Norte County: Foliated plates of graphite are found in the limestone near Gasquet.

Fresno County: It is a prominent mineral in the rocks near Dunlap and at Borer Hill. Graphite schists occur on the Kean and Ruth ranches, 4 miles east of Squaw Valley; also on Sycamore Creek, near Trimmer.

Humboldt County: Graphite occurs near Eureka. Small deposits at Auto Rest on the South Fork of Trinity River.

Imperial County: A good grade of graphite is found 7 miles northwest of Coyote Wells on the San Diego and Arizona Railroad.

Inyo County: Graphite occurs 18 miles east of Independence.

Los Angeles County: It is found on the northern slopes of the Verdugo Hills, southwest of the San Gabriel Range. In the San Fernando area, one deposit occurs in Kagel Canyon and two in Pacoima Canyon. Another deposit is located on the west side of San Francisquito Canyon, near its head, and two more occur in the upper part of Elizabeth Lake Canyon, near its junction with the San Andreas Rift

Valley. These occurrences are all found in the schistose rocks of the shear zones which are related to a complex system of faults traversing the San Gabriel Range, Beverly (34).

A deposit occurs in Secs. 11 and 12, T. 6 N., R. 15 W., S. B. M., in Bouquet Canyon, that has been worked at intervals over a period of 25 years, Simpson (34). Graphite occurs in nodular masses and veins in schist or gneiss in Evey Canyon, a tributary of San Antonio Canyon.

Mendocino County: Graphite for paint and lubricant has been obtained from a deposit about 15 miles east of Point Arena.

Monterey County: Graphite is disseminated in the limestones and metamorphics of the Santa Lucia Range south of Monterey.

Riverside County: Flakes of graphite are prominent with brucite in the limestone at Crestmore. Good quality graphite is found near Temecula.

San Bernardino County: Large deposits are said to exist in the San Bernardino mountains, 15 miles from East Highlands. Graphite is found as a constituent of the limestone near Colton and near Oro Grande. It occurs in nodular masses and veins in schist and gneiss in San Antonio Canyon.

San Diego County: Graphite in mica schist occurs near Masons.

Santa Cruz County: It occurs in flakes and foliated masses at the limestone quarries near Santa Cruz.

Sierra County: Graphite is found in veins and wall rock of the Eldorado, Plumbago and Oriental mines of the Alleghany district, Ferguson and Gannett (32).

Siskiyou County: It has been reported from the head of Kelsey Creek in the Marble Mountain district, and from the headwaters of the East Branch of Seiad Creek.

Sonoma County: Deposits occur near Guerneville; 4 miles west of Healdsburg, and 4 miles south of Petaluma. Specimens have come from Cazadero, Pine Flat and Santa Rosa.

Tulare County: Graphite occurs in metamorphic rock in Drum Valley north of Auckland, and on quartz at Three Rivers.

Tuolumne County: Large foliated masses and dull earthy masses of graphite occur in the limestones north of Sonora, near Columbia. Graphite has been mined here.

SULPHUR

Native sulphur, S.

Orthorhombic. Pyramidal and thick tabular crystals. Also massive, incrusting, and in powder. Brittle. Resinous. Yellow, brownish or greenish-yellow. Streak white. $H = 1\frac{1}{2} - 2\frac{1}{2}$. $G. = 2.05 - 2.09$.

Burns with a bluish flame. Insoluble in water. Readily distinguished by the color, fusibility, and combustibility.

Yellow sulphur is common in the vicinity of geysers, hot springs and volcanoes. It is also found in gypsum beds, and in association with borax.

Alpine County: Sulphur occurs in brecciated tuff and is produced at the Leviathan mine, Leviathan Peak district, 10 miles east of Markleeville, W. W. Bradley (35).

Colusa County: On the banks of Sulphur Creek solfataric action has produced fine crystallized masses and granular coatings of sulphur, sometimes in association with cinnabar, Fairbanks (94). Good specimens have come from the Manzanita and the Elgin quicksilver mines, the latter also at one time being the scene of a small commercial output of sulphur.

Imperial County: The solfataric vents near Volcano have rims of sulphur crystals and salt. They have been described by Hanks (82a). A small sulphur deposit occurs on the eastern slope of Coyote Mountain.

Inyo County: A deposit occurs at Sulphur Bank on Owens Lake, near Olancha. Sulphur has been found with fluorite and gypsum in the Defiance mine. Sulphur deposited by solfataric action occurs in an area of several acres, 9 miles east of Coso Junction, Tucker (26). A small deposit is reported in the mountains east of Big Pine, and a number of deposits of sulphur in limestone occur in the Last Chance Range, Hamilton (21).

Kern County: On both sides of the San Joaquin Valley impure beds of gypsum and limestone occur, having considerable sulphur intermixed. Sulphur occurs with alum in the Sunset district.

Lake County: An interesting deposit at the Sulphur Bank quicksilver mine on Clear Lake was described by Le Conte and Rising (82), and by Becker (88). The black basaltic rock which outcrops on the lake has been bleached white and altered to a porous mass of silica by the action of fumes coming from several vents. Brilliant crystals of sulphur and acicular crystals of cinnabar have formed in the pores and cavities of this altered mass of rock. The forms of the sulphur crystals are: (111), (113), (011), (101), and (001). Sulphur was obtained in considerable quantity commercially from this deposit before it was found to overlie a richer deposit of cinnabar. Sulphur also occurred with borax at Little Borax Lake, just south of Clear Lake.

Mariposa County: Crystals of sulphur have been found with cinnabar on Horseshoe Bend Mountain, near Coulterville.

Mono County: It occasionally occurs in large balls filling cavities in the andalusite ore at the mine of Champion Sillimanite, Incorporated, on the western slope of the White Mountains, 7 miles east of Molcano, Melhase (25).

San Bernardino County: It occurs at Searles Lake as one of the many associated minerals of borax. Sulphur occurs in lenticular masses of mixed salts in the Calico Hills, 6 miles from Yermo, Foshag (31b).

Santa Barbara County: Sulphur crystals occur at Point Rincon, and on the north side of Graciosa Ridge, south of the Santa Maria Valley, at openings caused by the escape of gases from burnt shales, Arnold and Anderson (07).

Shasta County: It occurs in the gossans of the copper belt, L. C. Raymond (35); at Bumpass Hell and Supan Springs in Lassen Volcanic National Park, Day and Allen (25).

Siskiyou County: Crystals of sulphur and gypsum are abundant at the spring near the summit of Mount Shasta, H. Williams (34).

Sonoma County: Sulphur is found at The Geysers.

Ventura County: Deposits occur in Sulphur Mountain 3 miles east of Fillmore, and at the borate deposit of Frazier Mountain.

SEMI-METALS

ARSENIC

Native arsenic, As.

Hexagonal-rhombohedral. Generally granular massive; sometimes reticulated, reniform, stalactitic. Perfect basal cleavage. Brittle. Metallic. Color and streak tin-white, tarnishing to dark gray. H. = 3½. G. = 5.7.

Heated on charcoal, very volatile white fumes are obtained similar to antimony, but more difficult to catch on the coal; fumes have strong garlic odor.

Monterey County: The native metal was said to have been found in the old Alisal mine on El Rancho Alisal, about eight miles southeast of Salinas, in the foothills of the Gabilan Range, W. P. Blake (58). This mine contained a small body of argentiferous galena and sphalerite.

Nevada County: A specimen in the Museum of the State Division of Mines, from the Alcalde gold mine, near Grass Valley, contains native arsenic with stibnite in a calcite gangue. Small botryoidal masses of native arsenic have been found on the 1600-ft. level of the Empire Mine, Grass Valley, Johnston (37).

TELLURIUM

Native tellurium, Te.

Hexagonal-rhombohedral. In prismatic crystals; commonly columnar to fine-granular massive. Perfect prismatic cleavage. Luster metallic. Color and streak tin-white. H. = 2 — 2½. G. = 6.2.

B. B. wholly volatile. Gives red solution in warm concentrated sulphuric acid.

Native tellurium is sometimes found in association with the tellurides of gold, silver, lead and bismuth. It is occasionally found in the gold concentrates when not visible in the ore, and has been reported from some of the mining districts of the State.

Butte County: Tellurium was reported to have occurred in a cavity in a fragment of unrounded coarse gold washed from gravel, Turner (98).

Calaveras County: Foliated masses of native tellurium with the gold tellurides occurred in the old Stanislaus mine and the Melones mine. Foliated tellurium was reported to have been found in one of the mines at Angels Camp by Genth (68).

Shasta County: Native tellurium was found in the Eureka mine, near Redding.

Tuolumne County: Some native tellurium has been found associated with tellurides of gold and silver in the mines near Tuttletown and Jamestown.

ANTIMONY

Native antimony, Sb.

Hexagonal-rhombohedral. Generally massive, lamellar. Perfect basal cleavage. Brittle. Metallic luster. Color and streak tin-white. H. = 3 — 3½. G. = 6.7.

B. B. on charcoal fuses very easily, and is wholly volatile giving a white coating. The white coating tinges the R. F. bluish-green. Crystallizes readily from fusion.

Antimony occurs in metal-bearing veins with silver, antimony, and arsenic ores, especially with stibnite.

El Dorado County: Specimens of native antimony have come from Pleasant Valley.

Kern County: There are notable deposits of antimony in the Havilah and Kernville districts. Deposits occur on a spur of the mountains bordering San Emigdio Canyon in Secs. 10 and 15, T. 9 N., R. 21 W., S. B. M., and 10 miles west of Koehn, in Secs. 5 and 6, T. 30 S., R. 36 E., M. D. M. Also found in Sec. 36, T. 26 S., R. 33 E., M. D. M., about 6 miles southeast of Isabella, and in Sec. 24, T. 27 S., R. 33 E., M. D. M., about 36 miles north of Caliente in the Valley View Mining district, Tucker (29). Specimens from the last location, also known as the Erskine Creek deposit, east of Vaughn, have been described by Behre (21).

BISMUTH

Native bismuth, Bi.

Hexagonal-rhombohedral. Usually in arborescent-reticulated shapes. Brittle. Metallic. Color and streak silver-white with reddish hue, tarnishing dark-brown. H. = 2½. G. = 9.8.

Heated on charcoal, it gives a lemon-yellow coating. Mixed with a flux of potassium iodide and sulphur and fused on charcoal, the coating is bright-red, which distinguishes it from lead, which is yellow.

Crystals and veinlets of metallic bismuth sometimes accompany ores of bismuth, cobalt, silver and gold. It is also occasionally found in pegmatitic veins.

Inyo County: Bismuth was found with bismutite at Big Pine Creek, and at Antelope Springs, Deep Spring Valley.

Mono County: It was found at Oasis.

Nevada County: The concentrated sulphides of the Providence mine, Nevada City district, contained bismuth, Lindgren (96).

San Diego County: Metallic bismuth has been obtained from the pegmatitic vein of quartz, lepidolite, feldspar, tourmaline and amblygonite at the Stewart mine of the American Lithia Company, at Pala. The mineral occurred in platy crystalline masses, and long irregular crystals, Kunz (03b). Bismuth is also found in small metallic cleavages in lepidolite at the Victor mine at Rincon, Rogers (10).

Tuolumne County: Minute crystals of bismuth have been observed in the gold ore at the Soulsby mine.

METALS

GOLD

Native gold, Au.

Isometric. Good crystals are rare. Common in grains, scales, plates, and arborescent forms. No cleavage. Highly malleable and ductile. Metallic. Color and streak gold-yellow. H. = 2½ — 3. G. = 15.6 — 19.3.

Unaffected by any single acid, but soluble in the combined hydrochloric-nitric acids called aqua regia. Its insolubility in nitric acid distinguishes it from chalcopyrite and pyrite.

Gold has a very wide distribution in California. It has been found in every county and is now produced in two-thirds of them. Practically all of the gold exists as the native metal, either as free gold in the quartz and gravels or else mechanically mixed with the sulphides of iron, copper, lead or zinc. Tellurides of gold occur, but they are quite subordinate in quantity.

Crystals, arborescent groups, spongiform masses, wires, plates, scales, grains, nuggets and all shapes known for gold have been found. Cubes, rhombic-dodecahedrons and octahedrons are the prevailing forms of the crystals. The forms given by E. S. Dana (86) and Alger (50)

for some placer gold crystals were: (111), (311), (18.10.1), and (421), with twinning on the octahedral plane.

Crystalline masses and nuggets of large size have occurred in the placer gravels and in the pockets of quartz veins. A specimen found in 1854 at Carson Hill, Calaveras County, weighed 2,340 troy ounces, and another found in 1860 at the Monumental mine, Sierra Buttes, weighed 1,596 ounces. Many valuable nuggets and masses have been found and Hanks (82) gives a descriptive list of some of them.

Gold in quartz is the usual association, and the mineral is often in the quartz in such a finely divided state as to be invisible, even in high-grade ore, Silliman (67). Flaky gold has been found implanted on clear quartz crystals at Placerville and elsewhere.

Gold in pyrite, or 'auriferous pyrite' is abundant and is the source of much of the gold produced in the State.

Gold in arsenopyrite is common in the Mother Lode region and in the Alleghany district, Sierra County.

Calcite is a common gangue mineral with gold, and in some of the mines it is found with wires and scales of included gold. Lenticular masses of calcite with gold were found in Minersville, Trinity County, Diller (90). Gold has been found with calcite in the Soulsby mine, Tuolumne County, in the Calico district, San Bernardino County; and in the Alcalde mine, Nevada County.

Gold in barite is uncommon, though barite is a gangue mineral in the copper-gold districts as well as in the silver-lead districts. It occurs in barite at Pine Grove, Amador County; at the Malakoff mine, North Bloomfield, Nevada County; in the barite of some of the Shasta County copper mines.

Gold in cinnabar is an exceptional occurrence, yet the association has been noted in a few localities. At the old Manzanita mine in the Sulphur Creek district, Colusa County, minute specks of gold occurred in the cinnabar and implanted on cinnabar crystals; also in the old Redington or Boston mine, Knoxville, Napa County, some gold has been found with the cinnabar, and likewise near Coulterville, in Horseshoe Bend Mountain, Mariposa County.

Gold has also been observed with graphite, galena, altaite, petzite, hessite, tetradymite, calaverite, native tellurium, chalcopyrite, chalcocite, native bismuth, stibnite, sphalerite, tetrahedrite, fluorite, chalcedony, jasper, cuprite, magnetite, hematite, limonite, pyrolusite, dolomite, ankerite, rhodocrosite, siderite, albite, rhodonite, chlorite, roscoelite, talc, serpentine, asbestos, chrysocolla, asphaltum, and many other minerals. Gold is not confined to one class of rocks, but the gold-bearing quartz veins are principally in metamorphic schists and slates.

Primary deposits occur along the Mother Lode Belt, at various points in the Sierra Nevada, east and north of the Lode and in isolated ranges in the northwestern and southeastern part of the State. The western slopes of the Sierra Nevada where the main streams leave their deep canyons to enter the valley, the large river courses in the northwest, and parts of the desert regions in the southeastern part of the State are important placer mining areas.

Some gold is found in the Coast Range and some is mined in the southern counties, but the great bulk of it comes from the northern half of the State and from counties along the Sierra Nevada.

Gold occurs in so many localities in the State that it would be impossible to cite all of them. The literature on the gold deposits is also extensive. The gold placers of California have been described in Bulletin No. 92 of the State Division of Mines, and the Mother Lode Gold Belt has been described in Bulletin No. 108. Professional Papers 73 and 157 of the United States Geological Survey are the best authorities on the Tertiary Gravels of the Sierra Nevada and the Mother Lode Gold Belt, respectively.

The leading lode-gold producing counties of the State are: Amador, Calaveras, El Dorado, Kern, Mariposa, Nevada, Shasta, Siskiyou, Sierra, Trinity and Tuolumne.

The leading placer-gold producing counties of the State are: Butte, Merced, Placer, Sacramento, Stanislaus and Yuba.

Amador County: The Mother Lode crosses the county. Some of the famous mines are: The Argonaut and Kennedy mines at Jackson; the Central Eureka mine at Sutter Creek; and the Plymouth mine at Plymouth. The Bunker Hill, Fremont, Keystone and Amador mines at Amador City were noted mines.

Butte County: Much of the gold of this county has come from dredging operations along the Feather River at Oroville and other towns. Cherokee Flat, Forbestown and Magalia are old noted places.

Calaveras County: The Mother Lode crosses this county. Some of the noted mines were: the Utica, Angels, and Lightner mines at Angels Camp; the Gwin mine near Mokelumne Hill and the Sheep Ranch mine at Sheepranch. The Carson Hill mine at Melones is one of the largest producers in the State.

El Dorado County: Placerville, Georgetown, El Dorado, Grizzly Flats, Shingle Springs and Greenwood are all noted districts.

Kern County: The Yellow Aster mine at Randsburg has been the largest producer of the southern mines. The Amalie, Cove, Tehachapi, Mojave, Rand and Stringer districts are well known.

Mariposa County: The Princeton and other mines on the Mariposa Estate, the mines near Coulterville, Hornitos and Bagby were all noted producers. Rogers (32) has described crystals of gold from the North Duncan mine near Hornitos.

Merced County: The Merced unit and the Snelling Dredge at Snelling are large producers.

Nevada County: The Grass Valley and Nevada City mines have been the largest producers of gold. The Empire, Idaho-Maryland, North Star, and Murchie mines are among the most noted in the State. Native gold collected by W. D. Johnson, Jr., from Grass Valley was analyzed by E. T. Erickson, Wells (37).

Au	Ag	undetermined	
84.37	11.56	4.07	=100%

Placer County: Auburn, Colfax, Emigrant Gap, Gold Run, Blue Canyon, Dutch Flat, Michigan Bluff, Forest Hill and Weimar are historical mining districts, mostly for placer mining.

Sacramento County: Most of the gold of this county is obtained by dredging along the ancient courses of the American River near Fair Oaks, Folsom and Natomas.

Shasta County: This is more of a copper county, but considerable gold is produced. The largest quartz mines are in French Gulch and Harrison Gulch. Much of the gold is obtained from smelting copper ores.

Sierra County: The gold mines are mostly on the Sierra Buttes, on Kanaka Creek, and near Downieville, Alleghany and LaPorte. The Original 16 to 1 and Tightner at Alleghany are leading producers of gold.

Siskiyou County: Both quartz and placer mining are carried on in the county. Sawyers Bar, Scott Bar, Humbug Creek, Callahan, Happy Camp, Quartz Valley, Klamath River and Scott River are noted districts. The Black Bear group of quartz mines near Sawyers Bar has been the largest producer. Fine large nuggets have come from the placers.

Trinity County: The principal mines are centered around the famous towns of Minersville, Trinity Center, Deadwood, Douglas City, Carrville, Lewiston, and Weaverville.

Tuolumne County: The Mother Lode crosses the county and many noted mines are along it. Sonora, Columbia, Soulsbyville, Tuolumne, Jamestown, Tuttletown, Big Oak Flat, Chinese Camp, Stent and Groveland are all noted places.

Yuba County: Most of the gold of this county is obtained from dredging operations along the Yuba River. Some quartz and pocket mining is also done.

Fresno, Humboldt, Inyo, Lassen, Los Angeles, Mono, Plumas, Riverside, San Bernardino, and San Diego counties also produce gold.

GOLD AMALGAM.—A native alloy of gold and mercury very rarely found.

Mariposa County: It occurred in some of the mines near Mariposa and was analyzed by Sonnenschein (54).

Analyses:	Au	Hg
	39.02	60.98%
	41.63	58.37%

Nevada County: It was reported from the Odin shaft, Grass Valley, by Lindgren (96).

ELECTRUM.—A pale-yellow alloy of gold and silver of rather frequent occurrence where considerable silver is found with gold.

Imperial County: A considerable quantity of electrum is said to have been found in the Oro Plata mine, in the extreme eastern part of the county.

Madera County: Wire electrum occurred with gold in Fine Gold Gulch.

Placer County: It occurred in the Moore mine, Ophir district, according to Lindgren (94), and was analyzed by Hillebrand.

Analysis:	Ag	Au
	27.91	72.09%

BISMUTH GOLD.—An alloy containing about 60 per cent gold and 40 per cent bismuth.

El Dorado County: It was observed in the Coon Hollow mine, near Placerville.

SILVER

Native silver, Ag.

Isometric. Crystals rare. Acicular, reticulated, or arborescent; also massive. Ductile and malleable. Luster metallic. Color and streak silver-white, often gray to black by tarnish.

H. = $2\frac{1}{2}$ — 3. G. = 10.1 — 11.1, pure 10.5.

B. B. on charcoal fuses easily to a silver-white globule. Easily soluble in nitric acid, giving on addition of hydrochloric acid a curdy white precipitate of silver chloride, which turns dark on exposure to light.

Native silver has not been found in any large masses in the State, yet it is present in many gold and copper districts, and occasionally arborescent crystallizations, wires, and thin sheets are found. It is

more common in the silver-lead districts, where it often occurs near the walls of veins and intrusive dikes.

Alpine County: Good specimens of native silver have come from the Silver Mountain district.

Calaveras County: It occurred in arborescent forms with the copper ore at Quail Hill.

Inyo County: Occasional sprinklings of native silver occur with argentite in the quartz-calcite veins of Saline Valley, about 30 miles northeast of Mount Whitney, Warner (26).

Kern County: It occurs with the silver minerals in the Amalie district and near Garlock.

Los Angeles County: Native silver was associated with argentite, and with cobalt and nickel minerals at the Kelsey mine, near San Gabriel Canyon.

Madera County: Silver occurs in quartz veins at the Sullenger property, 3 miles northwest of Agnew Meadows on the eastern slope of Middle Fork Canyon, Erwin (34).

Mono County: It occurs in narrow veins cutting granitic rocks on Blind Spring Hill at Benton. Good specimens have come from the Diana and Comanche mines of this district. Some native silver occurs in the Silverado mine in the Patterson mining district. At Bodie it has been found with the copper-gold ores.

Placer County: Silver occurred at the Gold Blossom and the California mines in the Ophir district, Lindgren (94).

Plumas County: Native silver has been found in the old Pocahontas mine, associated with native copper and cuprite.

San Bernardino County: The Calico district described by Lindgren (87), and Storms, (93), the Grapevine district, the Silver Reef district, and the Silver Mountain district have produced some native silver with the cerargyrite and embolite. Native silver with gold occurs in the Avawatz Mountains.

Shasta County: Native silver is rare in the copper deposits of this county, but a few arborescent specimens have come from the Bully Hill, Afterthought and other mines. Fine crystallized silver occurred in the old Excelsior mine, Copper City, Fairbanks (93). Native silver in arborescent crystallization associated with stephanite, galena, and sphalerite, in a calcite-quartz gangue occurs at the Igo Consolidated mines.

COPPER

Native copper, Cu.

Isometric. Good crystals rare. Generally in wires, thin sheets and arborescent crystallizations. No cleavage. Malleable and ductile. Luster metallic. Color copper-red. Streak metallic, shining. H. = $2\frac{1}{2}$ — 3. G. = 8.8 — 8.9.

B. B. fuses readily. Soluble in nitric acid. The solution turns deep azure-blue with excess of ammonia.

Metallic copper has been found in most of the copper mines of the State, but no deposits of native copper are known. It is frequently mixed with cuprite and malachite in the oxidized zone of copper deposits, or found as coatings along the walls of copper veins, or near intrusive dikes, which have brought about a natural reduction of the ores. Most of the localities cited for chalcopyrite have yielded some native copper.

Alameda County: Fine arborescent crystallizations of native copper were found in the Alma pyrite mine at Leona Heights, East Oakland. The minerals of this mine have been described by Schaller (03).

Amador County: Arborescent masses of copper occurred in the old Newton mine.

Calaveras County: Some of the mines along the copper-sulphide belt, especially at Copperopolis and at Campo Seco, have produced native copper. It occurred with silver at Mokelumne Hill.

Colusa County: It is found in serpentine with cuprite and melaconite at the Gray Eagle mine; also at the Lion mine.

Del Norte County: Some large pieces of native copper have come from the Diamond Creek district and from the Pearl and Occidental mines.

El Dorado County: The old Cosumnes mine near Fairplay has yielded small masses of native copper with bornite, chalcocite and cuprite. The Alabaster Cave mine near Newcastle, the Cambrian mine near Placerville, the Ford mine near Georgetown and the Oest mine near Auburn have had native copper with the cuprite.

Glenn County: Large float pieces of native copper have been found a few miles north of Chrome Mountain and on Elk Creek.

Humboldt County: It occurs on Red Cap and Boise creeks, and at Horse Mountain.

Inyo County: The copper deposits in the Ubehebe Mountains contain native copper.

Lake County: It was observed as finely disseminated particles in the serpentine of this county.

Lassen County: Native copper occurred in epidote rock at the Lummis mine.

Los Angeles County: It was found at the Free Cuba mine, near Acton.

Mariposa County: Massive copper occurred with malachite in the Copper Queen mine.

Mendocino County: Sheets and grains of metallic copper occur at Red Mountain, 15 miles southeast of Ukiah, and in the serpentines in Lost Valley.

Merced County: Copper occurs with quartz and chalcopyrite in the Victor Bonanza mines.

Modoc County: It was observed with malachite and limonite near Fort Bidwell.

Mono County: It was found sparingly in the Lundy and Benton districts.

Monterey County: Native copper is disseminated in serpentine on Table Mountain, near Parkfield; also in serpentine with chalcopyrite near the summit of the Santa Lucia Range, 7 miles from Santa Lucia.

Nevada County: It occurs with cuprite and chalcocite at Meadow Lake.

Placer County: It occurred at the Algol mine near Spenceville, in sheets and hackly masses; at the Valley View mine, 6 miles from Lincoln; and on magnetite near Todd. Lindgren (94) reported native copper as one of the minerals of the Ophir district.

Plumas County: It occurs with rhodonite at Mumford's Hill. Large lumps occurred with cuprite, malachite and native silver in the old Pocohontas mine, Indian Valley.

Riverside County: It occurs in the McCoy Mountain district.

San Luis Obispo County: It occurred at the Tiptop mine, 10 miles north of San Luis Obispo, and on Chorro Creek.

Shasta County: Arborescent growths and compact masses of copper have been found in the Bully Hill mines, Copper City mines, Shasta King mine, Mountain Copper mine, Mammoth mine, Balaklala mine, Greenhorn mine, and Kosk Creek mine.

Siskiyou County: It occurs with pyrite and chalcopyrite at Preston Peak.

Tehama County: It was found on Elder Creek and at White Bluff.

Tulare County: Masses of copper have been found on the Middle Fork of Tule River, about 30 miles east of Porterville.

MERCURY—Quicksilver

Native mercury, Hg.

Liquid. Forms small fluid globules in the matrix which is usually cinnabar. Brilliant metallic luster. Color tin-white. G. = 13.59.

Vaporizes at comparatively low heat and disappears; the vapors are invisible. Soluble in nitric acid.

Liquid globules of mercury are common in most of the cinnabar mines, formed either by reduction of the sulphide or by sublimation of mercuric vapors. It occurs in deep workings and in those parts of ill-ventilated mines where intense heat is developed by the decomposition of iron sulphides. It is also frequently found near the walls of cinnabar veins.

Kings County: Mercury occurred with serpentine in the Kings mine.

Lake County: It was abundant in the gravels and with cinnabar in quartz veins in the Wall Street mine; occurred also in the Big Injun and Big Chief mines, west of Middletown.

Napa County: It was found in the mines at Oat Hill and Knoxville.

Orange County: Small amounts of native mercury have been reported to occur with veins of barite in sandstone, 2 miles east of Tustin.

San Benito County: It occurs in the cinnabar deposits at New Idria, and with cinnabar in serpentine at the Alpine Quicksilver mine.

San Francisco County: Liquid globules of mercury have been found in siliceous rock near Twin Peaks.

Santa Clara County: It is common in some of the shafts at New Almaden.

Sonoma County: It was prominent in the New Sonoma mine, Pine Flat district, 16 miles northeast of Healdsburg. Much native quicksilver occurred in the Rattlesnake and the Socrates (Pioneer) mines; in the Bright Hope (Esperanza) mine, near The Geysers; with cinnabar in the Clear Quill mine about 1 mile from the Great Eastern mine.

Trinity County: It was found with cinnabar at the Altoona mine.

LEAD

Native lead, Pb.

Isometric. Crystals rare. Usually in thin plates and pellets. Malleable. Metallic luster. Color lead-gray. H. = 1½. G. = 11.4.

Easily fusible. Heated on charcoal, it gives a yellow coating. Soluble in hot dilute nitric acid.

Native lead is an exceedingly rare mineral and its reported occurrence as a true mineral is sometimes doubtful. Small bits of lead found

in the placer gravels may be portions of lead bullets, but the occurrence of the metal in deep placer mines is indicative of its origin as a natural reduction product.

Butte County: Pieces of native lead found in a placer at Magalia were believed by Hanks (84) to be flattened bullets. Small angular fragments of native lead have been found at a prospect 14 miles east of Chico, on the West Fork of Feather River, Rogers (12).

Kern County: Several pieces of native lead have been found in the dry washings at Goler.

Placer County: Small pellets of native lead have been found in a placer mine in North Ravine, in the Edgewood district, adjoining the Ophir district.

PLATINUM

Native platinum, Pt.

Isometric. Generally occurs in grains and small nuggets. Malleable and ductile. Metallic luster. Color and streak whitish steel-gray. H. = 4 — 4½. G. = 14 — 19.

Platinum and the platinum group of minerals are soluble only in aqua regia. To detect small amounts of these minerals in sands, first concentrate by panning until a sufficient number of the gray metallic grains are obtained. Dissolve in aqua regia and in the clear solution add a few drops of potassium chloride, which will precipitate orange-yellow potassium platinic chloride.

Gray metallic grains and small nuggets of platinum were early observed in some of the gold-bearing black sands of the streams and beaches, and also in the concentrates from the gold washings. Little attempt was made to save the platinum and it is only in recent years that any record has been kept of the production. Though it occurs widely in the State, it has not been positively identified as a constituent of any rocks.

Analyses of California platinum have been made by Deville and Debray (59) and by Genth (52a).

	Pt	Ir	Iridos	Pd	Rh	Fe	Cu	Au	SiO_2
Deville and Debray	85.50	4.05	1.10	0.60	1.00	6.75	1.40	0.80	2.95
Genth	90.24	2.42	0.68	some	some	6.66	---	---	---

Most of the platinum is alloyed with iridium, osmium, palladium and other metals of the platinum group, and much of it would be classed as platiniridium. Many of the black sands have been investigated by Day and Richards (06).

Butte County: It is a constituent of the black sands of the Feather River and some of its tributaries, and the largest production is from the dredging operations at Oroville. It is present in the concentrates of Butte Creek, Brush Creek, Magalia, Cherokee, and Buchanan Hill.

Calaveras County: It has been observed in the concentrates at Douglas Flat and Mokelumne Hill.

Del Norte County: It occurs in the black sands at Crescent City, Day and Richards (06).

El Dorado County: Small amounts of native platinum have been recovered by the dredging operations of the Natomas Co. in T. 9 N., R. 7 E., M. D. M.

Humboldt County: It is one of the constituents of the gold-bearing beach sands at Gold Bluff, Day and Richards (06).

Inyo County: It is reported to have been found in the concentrates of the Mount Hope mine, near Citrus.

Kern County: Traces of platinum have been observed in the sands at Kane Springs.

Mariposa County: It is reported to have been found in Devils Gulch near the junction of Devil Creek and the South Fork of Merced River, about 5 miles from Jerseydale, Castello (21). The ore is said to carry mainly platinum, gold and small amounts of cobalt, nickel and tin.

Mendocino County: It occurs in the beach sands near Little River. Platinum minerals occur in the superficial deposits in the Russian River Valley, near Hopland. Gold and osmiridium accompany the platinum.

Merced County: The platinum mined since 1930 has come from the dredging operations of the Merced Dredging Co. and the Yuba Consolidated Gold Fields, near Snelling in T. 5 S, R. 14 and 15 E., M. D. M.

Nevada County: It occurs in the concentrates of the Rough and Ready district and in considerable amounts at Relief Hill.

Placer County: A few grains of platinum were found with placer gold on the North Fork of American River about 30 miles from Sacramento, Genth (52).

Plumas County: It occurs in the concentrates at Genesee, La Porte and Rock Island Hill.

San Bernardino County: Platinum has been identified in cerusite ore, associated with gold, silver and copper in the Piute mine, near Cima.

San Luis Obispo County: It has been observed in some of the beach sands.

Santa Barbara County: It is found in the beach sands at Lompoc and north of Point Sal.

Santa Cruz County: It occurs in some of the beach sands of the county.

Shasta County: It is found in the sands at Redding and on Cottonwood Creek. The black sands of Beegum Creek contain platinum, iridium and a little gold.

Siskiyou County: Platinum has been observed in the sands at Callahan, Castella, Henley, Happy Camp, Sawyers Bar, Oak Bar, Fort Jones, Hornbrook, Cecilville, Klamath River, and Rock Ranch.

Tehama County: It is found in the sands near Beegum.

Trinity County: Platinum was early observed as a constituent of the black sands of the Trinity River and its tributaries, and nuggets weighing several ounces have come from the county. Its presence has been shown in the sands at Douglas City, Burnt Ranch, Junction City, Big Bar, Hawkins Bar, Helena, and in the Hayfork district.

Ventura County: It has been observed in minute quantities in some of the beach sands.

Yuba County: It is found in the concentrates at Indian Hill, Camptonville, and near Hammonton in the Brownsville district.

PLATINIRIDIUM

Native alloy of platinum and iridium, (Pt,Ir).

Isometric. Generally in grains and nuggets. Metallic luster. Color silver-white. H. = 6 — 7. G. = 22.65 — 22.84.

Much of the so-called 'platinum' of the State is really this alloy, and several nuggets of a few ounces weight have been found along the Trinity River.

IRIDOSMINE—Osmiridum

Native alloy of iridium and osmium, (Ir,Os).

Hexagonal-rhombohedral. Generally in grains. Cleavage perfect basal. Metallic luster. Color tin-white to light steel-gray. H. = 6 — 7. G. = 19.3 — 21.12.

This alloy is a frequent associate of platinum and an analysis of it by Deville and Debray (59) shows the presence of the rarer metals, rhodium and ruthenium.

Ir	Rh	Ru	Os
53.50	2.60	0.50	43.40

Siserkite is a variety with not over 30 per cent iridium. According to Genth (52a) the composition of some gray metallic grains from California is:

Siserkite	49.4%
Platinum	48.4%
Platiniridium	2.2%
New element and gold	n.d.

Butte County: Iridosmine has been reported with platinum from the black sands at Cherokee, Silliman (73b).

Trinity County: Flakes and nuggets of iridosmine are found in the gravels of the New River, and the Trinity River and its tributaries.

IRON

Native iron, Fe.

Isometric. Generally massive. Malleable. Metallic luster. Color steel-gray to iron-black. H. = 4 — 5. G. = 7.3 — 7.8.

Its strong magnetism and the fact that it is malleable distinguishes it from all other iron minerals.

Iron occurs native chiefly as meteoric iron. Terrestrial iron is sometimes found in basaltic rocks, but its occurrence in this form is not known in the State. Meteoric iron has been found in six localities in California, and analyzed. Nickel and cobalt are always present in meteoric iron.

El Dorado County: An iron meteorite weighing 85 pounds, found near Shingle Springs in 1869 or 1870, was reported by Shepard (72) and later described by Silliman (73a) with analysis by F. A. Cairns:

Fe	Ni	Co	Al	Cr	Mg	Ca	C	Si
81.480	17.173	0.604	0.088	0.020	0.010	0.163	0.071	0.032

P	S	K	
0.308	0.012	0.026 = 99.987%	G. = 7.875.

Inyo County: An iron meteorite weighing 425 pounds, found 22 miles northeast of Big Pine, was described by G. P. Merrill (22) with analysis by Brinkley:

Fe	Ni	Co	S	P	Cu	C	insol.
89.89	7.65	0.45	0.12	0.01	tr.	0.03	1.88 = 100.03%

Kern County: A stony meteorite, weighing 80 pounds, found in the San Emigdio Mountains was described by G. P. Merrill (89) as coming from San Bernardino County: The metallic part, constituting 6.21 per cent of the stone, was analyzed by Whitfield (90):

Fe	Ni	Co
88.25	11.27	0.48 = 100%

San Bernardino County: An irregular mass of meteoric iron which weighed about 117 pounds was found in the Ivanpah district in 1880. Analyzed by Shepard (80), and by G. Gehring.

Analyses:

	Fe	Ni	Co	P	C	S	SiO_2	Graphite	
Shepard	94.98	4.52	---	0.07	0.10	---	---	--- = 99.67%	G. = 7.65.
Gehring	94.86	4.47	0.26	tr.	0.12	tr.	0.04	0.07 = 99.82%	G. = 8.076.

This meteorite was also studied by Cohen and Weinschenk (91), and by Cohen (92). It is now in the Museum of the State Division of Mines. A piece of meteoric iron weighing about 3½ pounds was

found in 1899 near Surprise Springs in the Bullion Range. It was analyzed by Cohen (01):

Fe	Ni	Co	Cu	Cr	S	P	C	Cl
91.01	7.65	0.89	0.07	0.04	0.08	0.22	0.02	0.02 = 100.00%

Trinity County: A small oval-shaped mass weighing 19 pounds was found at Canyon City about 1875, Ward (04). The surface was oxidized to limonite. Analysis of the purer portion was made by Shepard (85). Analysis:

Fe	Ni	Co	P	
88.81	7.28	0.17	0.12 = 96.38%	G. = 7.1.

AWARUITE

Native alloy of nickel and iron, $FeNi_2$.

Isometric. Grains and nuggets. Tin-white to steel-gray color. Magnetic. H. = 5. G. = 8.1.

Del Norte County: Small grains of awaruite averaging 0.15 to 1.5 mm in diameter were found in the residues from the gold washings of the South Fork of Smith River, associated with magnetite and chromite. Analyzed by Jamieson (05).

Ni	Fe	Co	Cu	P	S	
76.69	21.37	1.20	0.64	0.04	0.06 = 100%	G. = 7.85.

SULPHIDES AND TELLURIDES OF THE SEMI-METALS

Realgar	Stibnite	Tetradymite
Orpiment	Bismuthinite	Molybdenite

REALGAR

Arsenic monosulphide, AsS.

Monoclinic. Crystals short prismatic, striated vertically; also granular massive and incrustations. Sectile. Resinous luster. Color bright-red to orange-yellow. Streak orange-yellow. H. = $1\frac{1}{2}$ — 2. G. = 3.56.

Heated on charcoal, it gives volatile white fumes of arsenic oxide having a garlic odor. Soluble in caustic alkalies.

Alpine County: Deep-red realgar coating pyrite, with minute white octahedrons of arsenolite, occurred in the Monitor mine.

Imperial County: Kelley (36) has reported the occurrence of realgar with sulphur and claudetite at a sulphur prospect 6 miles north of the 4S ranch and $1\frac{1}{2}$ miles west of the Colorado River.

Kern County: A small amount of realgar occurs with borax and kernite in the borate mines of the Kramer district, Schaller (30).

San Bernardino County: Small crystals of realgar have been found with hanksite, pirssonite and halite in the salt beds of Searles Lake. Weeks (25) has reported that realgar occurs in the mines of the Calico district.

Sonoma County: Realgar occurs with metacinnabar and curtisite in the cracks and interstices of sandstone at Skaggs Springs, Wright and Allen (30).

ORPIMENT

Arsenic sulphide, As_2S_3.

Monoclinic. Usually in foliated masses. Perfect clinopinacoidal cleavage. Sectile. Pearly luster. Color lemon-yellow. Streak pale-yellow. H. = $1\frac{1}{2}$ — 2. G. = 3.4 — 3.5.

Like realgar in the reactions.

Readily distinguished from realgar by color. The two are usually associated and realgar alters into orpiment.

Lake County: Orpiment with realgar is said to have been found on the Eel River, about 15 miles northwest of Bartlett Springs.

Trinity County: Yellow orpiment occurs in the decomposition of the iron sulphides at the Island Mountain copper mine.

STIBNITE—Antimonite

Antimony sulphide, Sb_2S_3.

Orthorhombic. Long prismatic crystals, often bent and curved and with faces striated and furrowed. Cleavage perfect brachypinacoidal. Metallic luster. Color and streak lead-gray. H. = 2. G. = 4.52 — 4.62.

Melts in a candle flame. Heated on charcoal, it gives dense white coating and odor of sulphur. Soluble in hydrochloric acid.

Stibnite is the common ore of antimony, and good deposits of it exist in the State. It occurs generally as veins in granitic rocks and schists. In gold and copper districts it is a common associate of galena, sphalerite, chalcopyrite, pyrite and tetrahedrite. It is characteristically associated with cinnabar.

Calaveras County: Stibnite has been observed with gold at Mokelumne Hill, at the Oro y Plata Mine near Murphy, and in the Mother Lode region.

Contra Costa County: Stibnite occurs at the Mount Diablo quicksilver mine.

Inyo County: In the Cerro Gordo district stibnite was found with the silver-lead ores, and some limonite specimens from there seem to be pseudomorphs after long prismatic stibnite crystals. Large bodies of stibnite with cervantite are said to occur on the western slope of the Panamint Range near Wild Rose Springs. A large outcrop occurs on the eastern slope of the Argus Mountains, between Revenne and Shepherd canyons; also near Owens Lake.

Kern County: The deposits in the San Emigdio Mountains at the head of San Emigdio Canyon have long been known and were the first worked in the State, W. P. Blake (58). Veins of stibnite are plentiful in the mountains in the northeastern part of the county. On Erskine Creek stibnite has been found with native antimony. Stibnite also occurs in the Mammoth Silver mine in the Caliente district. Good crystalline stibnite occurs at Piute; in the Tom Moore mine, Clear Creek district; near Tehachapi; near Kernville; at Hot Springs; near Havilah; in the Cedar Creek mining district. It occurs in the Sierra Sue mine near Glennville. Minute spherulites of stibnite occur in kernite and borax in the Kramer district, Schaller (30).

Lake County: Stibnite has been found with cinnabar at Sulphur Bank, on Clear Lake.

Los Angeles County: Stibnite has been found in the mountains south of Lancaster.

Mariposa County: Stibnite occurs in the gold districts of the county.

Merced County: Fine specimens of prismatic stibnite have come from the McLeoud mining district.

Mono County: Stibnite is common in the Blind Spring Hill district, associated with the silver-lead ores, and good specimens have come from the Comanche, Comet and Diana mines.

Monterey County: Stibnite occurs about 9 miles from San Lucas.

Napa County: Fibrous bands of stibnite occurred with the cinnabar at the Manhattan and the Boston or old Redington mines at Knoxville.

Nevada County: Stibnite occurs with galena in quartz at the Red Ledge mine; also in the Mohawk antimony mine near Nevada City.

Placer County: It occurs with gold-bearing quartz in the St. Laurence mine, Ophir mining district.

Riverside County: Bunches of stibnite were found at the Crowell mine, 5 miles southeast of South Riverside. Fine-grained stibnite was found near Corona.

San Benito County: There are numerous veins of stibnite in association with the cinnabar deposits, especially in the northeastern part of the county. Fine crystallized specimens have come from the Rip Van Winkle, Alta, Gleason and Shriver claims on Antimony Peak, northeast of Hollister, and some of the crystals have the forms (010), (130), (110), (310), (210), (430), (113), (4.5.12), and (102), Eakle (08). Long divergent prisms of stibnite have come from the Blue Wing vein of the Stayton quicksilver mine.

San Bernardino County: Stibnite was found in a boulder at the Centennial mine. A small vein of stibnite associated with wolframite was found in Clark Mountain. It occurred with the scheelite at Atolia and in large crystals in the silver ores of the Rand district, Hulin (25).

San Diego County: Stibnite occurs on the Laguna Mountains; also 4 miles west of Jacumba.

San Luis Obispo County: It occurs near the head of San Simeon Creek; radiating prisms in quartz occur near Cambria; beautiful crystalline stibnite with pyrite in quartz occurs on the South Fork of San Simeon Creek, near the summit of the Santa Lucia Range.

Santa Clara County: Large divergent columnar masses have come from near Gilroy. Stibnite is an associate of cinnabar at the New Almaden quicksilver mines.

Sierra County: It occurs with the gold ores at Downieville.

Sonoma County: It occurs in small amounts on San Antone Creek, near the Marin County line.

Trinity County: It is found with quartz and pyrite near Weaverville; also found near Hayfork.

Tulare County: It is found in the Mineral King district as an associate of argentiferous galena; in quartz with pyrite on the Dennison Mountains; in a quartz vein cutting slate at the Lady Alice mine, a quarter of a mile south of Mineral King.

BISMUTHINITE

Bismuth sulphide, Bi_2S_3.

Orthorhombic. Usually fibrous massive. Metallic. Color and streak lead-gray. H. = 2. G. = 6.4 — 6.5.

Heated on charcoal, it gives a yellow coating and sulphur odor. Coating assumes a bright-red border when fused with potassium iodide and sulphur.

Bismuth has frequently been detected in the concentrates from several of the gold and copper districts, but the form in which it occurs has not in general been determined. Bismuthinite as a distinct mineral has only been noticed in a few localities.

Fresno County: Some small pieces of bismuthinite were found at the Second Sierra and Lot One mines, Kings River district. It is found about 20 miles north of Trimmer on the Kings River.

Inyo County: It is said to occur in some of the mines in the Kearsarge Mountains, near Independence.

Madera County: It was reported by Turner (96) as occurring in the ore of the Sierra Gold and Silver mine in the Minaret district.

Mono County: It is found with bismutite at Oasis.

Riverside County: It is found at the Lost Horse mine.

San Bernardino County: It occurred with bismutite in the United Tungsten Copper mine, Morongo district.

TETRADYMITE

Bismuth telluride, $Bi_2(Te,S)_3$.

Hexagonal-rhombohedral. Commonly in bladed forms foliated to granular massive. Cleavage perfect basal. Metallic luster. Color steel-gray. H. = $1\frac{1}{2}$ — 2. G. = 7.2 — 7.6.

Yields a yellow coating on charcoal which becomes bright red on its outer border when fused with the potassium iodide and sulphur flux.

The characteristic reaction for all tellurides is the violet solution obtained by boiling a little of the powdered mineral in a few drops of concentrated sulphuric acid.

Calaveras County: Tetradymite was found with gold in the Melones and in the Morgan mines on Carson Hill, associated with other tellurides of this famous telluride locality, Hanks (84).

Inyo County: It was found with rutile, chalcopyrite and bismutite in a brecciated quartz vein in the Cerro Gordo district, Webb (35).

Nevada County: It occurred at the old Murchie mine near Nevada City, Hanks (84).

Tuolumne County: Tetradymite was found with free gold in calcite and dolomite in the Jumper and Golden Rule mines near Jamestown, Sharwood (11).

MOLYBDENITE

Molybdenum disulphide, MoS_2.

Hexagonal. Usually in scales and foliated masses. Cleavage perfect basal. Metallic luster. Color lead-gray. Streak bluish to greenish-gray. H. = 1 — 1½. G = 4.7 — 4.8.

Fusible, giving sulphur odor. Soluble in nitric acid. This readily distinguishes it from graphite, which it closely resembles.

Molybdenite is the principal ore of molybdenum. The mineral is widely distributed in the State, occurring in small flakes and leaves in quartz veins and granites. It strongly resembles graphite but can generally be distinguished from that mineral by its lighter bluish lead-gray color and its occurrence with granitic rocks.

Amador County: Molybdenite occurs in the ore of the Zeila mine, near Jackson, Knopf (29).

Calaveras County: It occurs in the hanging-wall orebodies of the Carson Hill mine at Melones, Knopf (29).

El Dorado County: Broad foliated plates of molybdenite occur in a pegmatite vein with bornite, chalcopyrite, epidote, garnet, axinite, hornblende and orthoclase at the old Cosumnes copper mine, near Fairplay. It also occurs in plates at Grizzly Flats.

Fresno County: It occurs in quartz at the Kings River Canyon copper mine. Good broad plates have been found in the quartz rock of Green Mountain, on the South Fork of San Joaquin River. It occurs with calcite and epidote on the Kings River, 30 miles east of Trimmer. It occurs in flakes in the White Pine district.

Inyo County: It occurs in quartz on the White Mountains. A thick ledge containing much molybdenite was reported on the west side of Death Valley. Molybdenite occurs in large masses at the Pine Creek Tungsten mine. It occurs in a quartz vein at contact of granite and limestone at the Lucky Boy Prospect, 7 miles east of Kearsarge; on the upper part of Lone Pine Creek.

Madera County: Plates of molybdenite were found in the Speckerman mine at Fresno Flat. A small deposit of it occurs at Sugar Pine.

Mariposa County: Specks of molybdenite occur in a lens of garnet, epidote and quartz, on the southeastern slope of Mount Hoffman, Turner (98), and at Knights Creek near Big Trees, Turner (96). It occurs with molybdite in quartz in the Kinsley mining district 7 miles from El Portal.

Mono County: Molybdenite is found with molybdite at Cameron, near Bridgeport; in quartz at the Minnie mine, Sweetwater Range; with molybdite at Silverado Creek, Whiting (88). It is found with molybdite 1 mile north of Star City. It occurs in granite about 6 miles west of Sweetwater, Nevada; also in a quartz ledge 10 miles south of Fales Hot Springs.

Monterey County: It occurs in quartz on the Westcott ranch, 8 miles east of Soledad.

Napa County: It is found in quartz on Mount St. Helena.

Nevada County: Molybdenite occurred with limonite at Nevada City, Genth (59); in good plates in the Mayflower mine, Nevada City; in the Excelsior mine, Meadow Lake district; in the rocks of Signal Peak; in broad plates in white quartz near Truckee.

Placer County: It occurred in a granodiorite with copper minerals at the Elder mine, about 4 miles west of Clipper Gap. It occurred in some of the mines of the Ophir district, Lindgren (94). It occurs with pyrite in quartz near Cisco.

Plumas County: Broad plates of molybdenite occur in the Meadow Valley mining district.

Riverside County: Small flakes of molybdenite occur in thin pegmatite veins intersecting granite at a quarry about 4½ miles northeast of Corona.

San Diego County: It is found in granite at Campo; with malachite and chalcopyrite at Potrero and in the Grapevine mining district. It is found in an aplite dike about 6 miles west of Ramona, Calkins (16); with molybdite 20 miles north of Encinitas.

Shasta County: It occurs in granite on Hazel Creek and also on Tom Neal Mountain, near Delta; in aplite or alaskite with molybdite coatings, on Boulder Creek near Gibson where it has been concentrated by flotation and several tons produced.

Siskiyou County: It occurs in the Yellow Butte Copper mine, east of Weed, and near Dunsmuir.

Trinity County: It was found with molybdite near Lewiston, in Sec. 31, T. 33 N., R 8 W., M. D. M.; in quartz with pyrite near Helena.

Tulare County: Molybdenite occurs in plates at Three Rivers and with molybdite in the Mineral King district. Fine large foliated plates of molybdenite occur in granodiorite at the head of the Kaweah River.

Tuolumne County: It occurs in a quartz vein in granite on the south side of Knights Creek, northeast of Columbia; in a quartz vein

with garnet, epidote and sphalerite, about 3 miles west of Tower Peak, Turner (98).

Ventura County: It is reported from Frazier Mountain and McDonald Peak.

Yuba County: Plates of molybdenite with yellow molybdite occur in granitic rock near Camptonville.

SULPHIDES, SELENIDES, TELLURIDES and ARSENIDES of the METALS

Galena	Tiemannite	Chalcopyrite
Altaite	Coloradoite	Pyrite
Alabandite	Pentlandite	Cobaltite
Argentite	Cinnabar	Smaltite
Hessite	Greenockite	Marcasite
Petzite	Millerite	Löllingite
Chalcocite	Pyrrhotite	Arsenopyrite
Stromeyerite	Troilite	Melonite
Cubanite	Covellite	Sylvanite
Sphalerite	Bornite	Calaverite
Metacinnabar	Violarite	Nagyagite

GALENA

Lead Sulphide, PbS.

Isometric. Cubes and cubo-octahedrons common; also massive, coarse or fine granular. Cleavage perfect cubic. Metallic luster. Color and streak lead-gray. H. $= 2\frac{1}{2}$. G. $= 7.4 - 7.6$.

Heated on charcoal, a dense lemon-yellow coating forms and a slight odor of surphur can be detected. It is easily reduced to a bead of metallic lead.

Galena is a common mineral and is prominent in many of the gold, silver and copper districts. Much of it is argentiferous and forms the silver ore of the State. The characteristic associates are sphalerite, pyrite, tetrahedrite, chalcopyrite, barite, fluorite and calcite. Its two common alteration products, cerusite and anglesite, very often accompany it.

Alpine County: Argentiferous galena occurs in the Silver Mountain district. Argentiferous galena was observed in the Monitor mining district, Eakle (19).

Amador County: Galena is common in the mines near Plymouth and along the Mother Lode.

Butte County: It occurs with chalcopyrite and quartz in the Butte Creek mining district.

Calaveras County: It is found on Carson Hill; at Angels Camp, and in many of the mines of the Mother Lode. Galena occurs with sphalerite at the Buckhorn mine, Oromiento mine, Washington mine, Yaller Kid mine, Collier mine near Murphy; at Westpoint in the Star of the West mine and Gold Nugget mine; at the Comet mine on the Mokelumne River.

El Dorado County: Some of the mines of the county from which galena has been reported in the ores, usually accompanied by pyrite and sphalerite, are: Grand Victory mine, Diamond Springs; Flag-

staff, Mount Pleasant and Humbug mines of Grizzly Flats; Boneset and Vandalia mines near Shingle Springs; Pilot Hill mines.

Fresno County: It occurs at the Luakala mine, Contact mine, Fresno Chief mine and Jumper Claim near Spanish Peak.

Imperial County: Small veins and pockets occur 5 miles east of Picacho; large masses in the Paymaster mine in the northern part of Barren Mountain near the Colorado River.

Inyo County: Argentiferous galena has been the important silver ore of the county. At the old Modoc, San Felipe, Defiance, and other mines of the Cerro Gordo district galena formed the chief silver ore. It is common in the Panamint Range, and fine crystals have come from the Blue Wing mine. It occurs in fine-grained masses at the Hidalgo mine. It occurs at the Blue Dick mine; Kingston Mountain; with cerusite in limestone at Chloride Cliff mine; in limestone with sphalerite at Camp Burgess; with smithsonite and cerusite in limestone at the Ophir mine, Slate Range; in the Deep Springs mining district; at the Morning Star mine, Saratoga Springs; in banded masses with chalcopyrite at the Custer mine; with cerusite at the Montezuma mine, 10 miles southeast of Big Pine; at the Marble Canyon mine, Opal mine, Lucky Hike Prospect, Nancy Hanks mine, and Daisy mine, in the Waucobe mining district; at the Union Mine, and Santa Rosa mine; in most of the mines of the Resting Springs district; with anglesite and cerusite in the Ubehebe mine; in the Darwin mining district; mined at the Monster mine on the eastern slope of the Inyo Mountains.

Kern County: It occurs in the mines near Garlock; with scheelite in Jawbone Canyon, Amalie district; with arsenopyrite at the Bright Star mine, Piute district.

Los Angeles County: Galena occurred at the Kelsey mine near San Gabriel Canyon. Argentiferous galena occurs in the Renton, Quarry and Blackjack mines near the eastern end of Santa Catalina Island, Gieser (27).

Madera County: Large cubes of galena have come from the Star mine, Mount Raymond district. It occurred at the Gambetta mine, Grub Gulch. Argentiferous galena is one of the principal ore minerals in the Silver King, Galena King and Nidever groups of claims in the Minaret district, Erwin (34).

Mariposa County: It occurs with light-yellow sphalerite disseminated through auriferous quartz in the Treasure mine, Quartzburg district; also in the Moore Hill and Bondurant mines.

Mono County: This is one of the silver-lead counties and argentiferous galena forms important bodies of ore. It is very common in

the Bodie, Benton and Lundy districts and in the claims on the Sweetwater Range.

Monterey County: Small veins of argentiferous galena occurred in the old Alisal mine on El Rancho Alisal, about 8 miles southeast of Salinas, W. P. Blake (58).

Napa County: Galena occurs with the gold and silver ores of the Palisades mine, 2 miles north of Calistoga.

Nevada County: Galena is found in the Meadow Lake and other mining districts of the county. It is mentioned by Lindgren (96) as one of the minerals of the mines at Grass Valley and Nevada City.

Orange County: Argentiferous galena occurs in the Silverado district; at the Blue Light mine, Santiago Canyon.

Placer County: It is found at several of the mines in the Ophir district; also in the Last Chance, Weimar, Michigan Bluff, Butcher Ranch, Dutch Flat, Canada Hill, Deadwood and Rock Creek districts.

Plumas County: It occurs in the Meadow Valley and Light's Canyon districts; at the Plumas Eureka mine; in the Butte Bar mine; with gold at Granite Basin; on the Feather River a few miles above Quincy.

Riverside County: It is found in the Free Coinage mine, the Steele mine and Gold Galena mine. Masses and cubes of galena are associated with garnet, quartz, sphalerite, pyrite and chalcopyrite at Crestmore, Eakle (17).

Sacramento County: It occurred with sphalerite and pyrite at Michigan Bar, Hanks (84).

San Bernardino County: It is common in the Silver Mountain, Silver Reef, and Calico districts. It occurs with linarite, anglesite, cerusite and smithsonite in a dolomitic limestone at the Ibex mine, Black Mountains, 6 miles north of Saratoga Springs.

San Diego County: A small body of galena occurs in mica schist north of Valley Center.

Shasta County: It occurs in most of the copper mines.

Sierra County: It occurs in the Pride, Ironsides, Phoenix, Sierra Buttes, Willowby, Alhambra, Bullion, Four Hills, Gold Canyon, Black Jack Alaska, Kanaka, Nixon and other mines.

Siskiyou County: Argentiferous galena occurs near Callahan; also at the Siskiyou mine, Seiad Valley; Hunter mine; near Yreka; altered to anglesite and cerusite at Happy Camp.

Tehama County: It occurs on Cow Creek, Hanks (84).

Trinity County: It was reported from Dobbyn Creek near Grizzly Creek.

Tulare County: It is prominent at the White Chief mine in the Mineral King district.

Tuolumne County: Galena occurred with gold in quartz at the Marble Springs mine, W. P. Blake (58). It was found at the Soulsby mine, and with pyrite and sphalerite in the mines on Quartz Mountain and Whiskey Hill; also at the Black Oak, Mount Dana, Santa Maria, Porto Fino, Platt, Mary Ellen, Keltz, Rising Sun, Golden Treasure, Juliana Bar, Star, Seminole, Providence, Carlotta, Gem, Sonnet and Experimental mines.

Ventura County: It occurs with pyrite in the Long Dave mine near Stauffer.

ALTAITE

Lead telluride, PbTe.

Isometric. Small octahedrons and massive. Metallic luster. Sectile. Color tin-white to dark-gray, with a yellowish tinge tarnishing to bronze-yellow. H. = 3. G. = 8.16.

The yellow coating of lead and the violet solution for tellurium serve to determine it.

Altaite is found associated with hessite, petzite and gold tellurides in a few localities.

Calaveras County: Altaite occurred with hessite and petzite at the Stanislaus mine, Carson Hill, and was analyzed by Genth (68).

Pb	Ag	Au	Te
60.71	1.17	0.26	3.31 = 99.45%

Nevada County: It was one of the minerals at the Providence mine, Nevada City, occurring in bunches in the Ural vein intergrown with native gold and associated with quartz, pyrite, and galena, Lindgren (96). Altaite has been found in the ore of the Champion mine, Johnston (38).

Tuolumne County: It occurred in the Golden Rule mine near Tuttletown, Genth (68). It was also found at Sawmill Flat with the forms (111), and (322), and was partly analyzed by Sharwood, Eakle (01).

Te	Pb	Ag	Au	Fe	Se	S
32.5	65.0	0.1	none	tr.	tr.	tr.

"Clusters of gold-altaite crystals" have been found in the Bonanza and O'Hara mines near Sonora, Sharwood (11).

ALABANDITE

Manganese sulphide, MnS.

Isometric. Usually granular massive. Perfect cubic cleavage. Sub-metallic. Iron-black to dark-brown. Streak green. H. = 3½ — 4. G. = 3.95 — 4.04.

The roasted mineral gives a manganese bead with borax. Soluble in hydrochloric acid with the evolution of hydrogen sulphide.

Manganese occurs usually as oxides or oxygen compounds, but

the sulphide is found occasionally as a vein mineral in metallic sulphide deposits, especially with sulphides of copper.

San Diego County: Specimens of alabandite have come from this county, perhaps from the Julian district.

ARGENTITE

Silver sulphide, Ag_2S.

Isometric. Octahedral crystals, often distorted. Commonly in arborescent and reticulated shapes. Sectile. Metallic luster. Color dark lead-gray to black. Streak black. H. = 2 — 2½. G. = 7.2 — 7.36.

Heated on charcoal, it gives a slight odor of sulphur and is readily reduced to a bead of metallic silver.

Alpine County: Small octahedral crystals of argentite are said to have come from the Advance mine in the Monitor district.

Inyo County: Argentite is common at the Cerro Gordo mine. It occurs massive and in crystals in the Oriental mine, Deep Spring Valley. Is occurs as an important silver mineral in the Minietta Belle mine. Argentite occurs with native silver in quartz-calcite veins in Saline Valley, Warner (26).

Kern County: Argentite occurs with tetrahedrite and pyrargyrite at the Amalie mine. Crystals of argentite with native silver have been found in the Silver King mine, near Garlock. It occurs at the Golden Queen mine on the western slope of Soledad Mountain, 7 miles south of Mojave, Tucker (34).

Los Angeles County: It is found in the Kelsey mine, near San Gabriel Canyon, associated with native silver, erythrite, smaltite, and annabergite. It is also found at Silverado with argentiferous galena.

Mariposa County: The Bryant Silver mine contained argentite and ruby silver.

Mono County: It was found sparingly in the Bodie and Benton districts with gold, tetrahedrite, sphalerite, chalcopyrite and galena. The mines in the Sweetwater Range, north of Bridgeport, contained argentite with gold, cerargyrite, tetrahedrite, and native silver.

Napa County: Argentite occurs at the Palisades mine, about 2 miles north of Calistoga.

Nevada County: It is mentioned by Lindgren (96) as occurring in the Allison Ranch mine, near Nevada City.

San Bernardino County: The mines of the New York Mountains, near Manvel, and also the old Imperial and Tiptop mines show some argentite. The Lava Beds district has produced crystals of argentite. It occurred to some extent with cerargyrite in the Calico and Barstow mining districts. It is found with galena, chalcopyrite, and pyrite in the Goldstone district.

HESSITE

Silver telluride, Ag_2Te.

Isometric. Generally in distorted octahedrons. Sometimes massive. Metallic luster. Color lead-gray to steel-gray. Streak dark gray to black. H. = 2½ — 3. G. = 8.31 — 8.45.

Easily reduced to a metallic button of silver when fused on charcoal, and yields a white coating of telluric oxide. Gives the tellurium reaction like tetradymite.

Hessite generally contains gold and often grades into petzite so the two tellurides are apt to be together in mines. They occur in most mines where gold tellurides are found, often associated with sylvanite or calaverite.

Calaveras County: Hessite was one of the tellurides of the old Stanislaus mine on Carson Hill. It was analyzed by Genth (68).

Au	Ag	Pb	Ni	Te	
3.28	46.34	1.65	4.71	44.45	100.43%
3.22	55.60	---	1.54	(39.64)	

It occurs in the Ford mine, half a mile east of San Andreas, Knopf (29).

El Dorado County: It was found massive as a drift specimen with galena and inclosing gold at Georgetown, W. P. Blake (57). It was reported to occur in the Barnes Eureka mine, 3 miles northeast of Shingle Springs.

Kern County: Hessite has been observed with the silver minerals at the Amalie mine.

Mono County: It has been found in the upper workings of the Silverado mine in the Patterson mining district.

Nevada County: A specimen of pyrite, galena, and native gold from the Nevada City mine contained some soft gray hessite, Lindgren (96). Hessite also occurs in the Idaho-Maryland mine.

Shasta County: It was found in the Shearer and Rattler mine, 3 miles from Redding.

Sierra County: It was found in the Golden King mine on Kanaka Creek, near Alleghany.

Trinity County: Hessite occurs in some of the mines of the Carrville district.

Tuolumne County: It occurred in the old Reist mine on Whiskey Hill, Silliman (68), and in the Jumper and Bonanza mines near Jamestown.

PETZITE

Silver and gold telluride, $(Ag,Au)_2Te$.

Isometric. Massive. Metallic luster. Color steel-gray to black. Streak black. H. = $2\frac{1}{2}$ — 3. G. = 8.7 — 9.0.

Similar to hessite in its reactions, but yields more gold to the buttons. Hessite and petzite may grade into each other so as to be indistinguishable by the blowpipe.

Petzite is usually associated with hessite, sylvanite and calaverite. It is the commonest gold telluride found in the State.

Calaveras County: Petzite was found with hessite in the Stanislaus and Melones mines on Carson Hill. Specimens from the Stanislaus mine have been analyzed by Genth (68) and Küstel (65).

	Au	Ag	Te
Genth	25.55	41.93	32.52
	25.70	42.36	31.94
Küstel	24.80	40.60	35.40

It occurs in the Ford mine, half a mile east of San Andreas, Knopf (29).

El Dorado County: It was found with calaverite at the Darling mine about 3 miles northeast of American Flat.

Nevada County: Petzite occurs in the Idaho-Maryland mine.

Siskiyou County: It has been found in the northern part of the county near the State line, with calaverite and free gold.

Trinity County: Petzite occurs in some of the gold ores of the Coffee Creek district, Stines (07).

Tuolumne County: Petzite is one of the tellurides that occurred in the Golden Rule, Rawhide Ranch and Norwegian mines near Tuttletown. It was analyzed from the Golden Rule mine by Genth (68) and from the Norwegian mine by Hillebrand (99).

	Au	Ag	Te	Se	Mo		
Golden Rule	25.60	41.86	32.68	--	--	= 100.14%	
	24.97	40.87	34.16	--	--	= 100.00%	
Norwegian	25.16	41.87	33.21	tr.	0.08	= 100.32%	G. = 8.925.

CHALCOCITE—Copper Glance—Redruthite

Cuprous sulphide, Cu_2S.

Orthorhombic. Crystals with deeply striated faces. Generally compact massive. Metallic luster. Color dark lead-gray to black. Streak black. Sectile. H. = $2\frac{1}{2}$ — 3. G. = 5.5 — 5.8.

Chalcocite is easily reduced to metallic copper on charcoal. Dissolved in nitric acid and adding ammonia produces a blue solution. Some reddish ferric hydrate is apt to be precipitated as an impurity.

Chalcocite is common in many of the copper mines of the State, but large bodies of this valuable copper mineral are rare. Bornite and chalcopyrite are often intermixed with the chalcocite, and malachite commonly coats the surfaces of specimens.

Alpine County: Probably the first copper claim in the State was the Uncle Billy Rogers claim located in 1855 in Hope Valley, in the northwest corner of the county. The claim was described as a chimney-shaped deposit in a garnet rock which carried some chalcopyrite, pyrite and chalcocite.

Calaveras County: Small amounts of massive chalcocite have been found in the copper deposits at Campo Seco and Copperopolis. It also occurred on Quail Hill, Silliman (67a). It occurred in small amounts in quartz at the Excelsior mine, Angels Camp; also in the Telegraph mine, Hog Hill.

Colusa County: It was found massive at the American mine.

Del Norte County: Chalcocite occurs in large masses with magnetite in serpentine on the Cleopatra claims, in the Diamond Creek mining district, about 18 miles east of Smith River, Hershey (08).

El Dorado County: It occurred with bornite and chalcopyrite in the old Cosumnes copper mine, near Fairplay; with bornite and chalcopyrite in serpentine at the Boston mine, Latrobe.

Humboldt County: It occurs in the Horse Mountain district. It occurs in large masses and disseminated particles in serpentine, with native copper, malachite, and cuprite, at the Iron Mountain mine.

Inyo County: Good specimens of massive chalcocite have come from the Ubehebe Mountains; chalcocite also occurs in the Minietta mine, Lookout mining district.

Kern County: It was found with chalcopyrite on Mesquite Mountain, near Garlock.

Lake County: It was found on the Langtry ranch, 7 miles south of Middletown.

Lassen County: A fine specimen of chalcocite has come from the Lummis mine.

Los Angeles County: It occurred in the mines at La Soledad Pass.

Madera County: It was found in the old Buchanan mine.

Mariposa County: It occurred in small amounts in some of the claims near Coulterville; in the Comet mine, Pocahontas mine, and at Hornitos.

Napa County: It occurred with covellite and malachite in the Jumper mines.

Nevada County: Chalcocite occurred with cuprite and malachite at the Oro Grande mine, Cisco; with native copper and cuprite at Meadow Lake.

Placer County: It is reported to have occurred in the Baker mine near Lincoln.

Plumas County: Rich copper ore consisting of chalcocite and bornite is found in the Genesee Valley and Light's Canyon districts. Chalcocite occurs with bornite and chalcopyrite in the Engels mine, Knopf and Anderson (30).

Riverside County: It was observed at the Mountain King mine. A little chalcocite is present with other sulphides in the limestone at Crestmore, Eakle (17).

San Benito County: Small grains of chalcocite occur in the natrolite with the benitoite of this county, Louderback (09).

San Bernardino County: Good specimens of chalcocite have come from the Silver Prize, Copper World, Francis, Arabella, Florence and Hettie mines. It occurs with bornite at the Francis Copper mine, Kelso district, Providence Mountains. It was found in a quartz porphyry 7 miles south of Ludlow; with bornite 4 miles east of Judson; with tenorite 38 miles east of Mojave.

San Diego County: It occurs massive at Potrero.

Shasta County: Chalcocite has been found in most of the copper mines of the county, but it is not prominent in any of them. Specimens of it have come from the Mountain Copper, Balaklala, Afterthought, Bully Hill and Copper City mines.

Sierra County: It was observed in the Four Hills mine.

Siskiyou County: It was intermixed with molybdenite at the Yellow Butte Copper mine, De Laney; in the Copper King mine; in the Bonanza mine near Honolulu.

Trinity County: Chalcocite occurred in the Copper Queen lode, Carrville district. It occurs with the pyrrhotite mass at Island Mountain.

Tuolumne County: It occurred in the Whiskey Hill mines, Silliman (67a).

STROMEYERITE

Silver and copper sulphide, $(Ag,Cu)_2S$.

Orthorhombic. Generally compact massive. Metallic luster. Color and streak dark steel-gray. $H.=2\frac{1}{2}-2$. $G.=6.15-6.3$.

Dissolves in nitric acid; a few drops of hydrochloric acid added to the solution produce a precipitate of white silver chloride. Ammonia added to solution dissolves this precipitate and the solution turns deep blue.

Alpine County: Stromeyerite was observed in the Monitor mining district, Eakle (19).

Inyo County: The Silver Queen and other mines of the Panamint Range contained stromeyerite with tetrahedrite and cerargyrite. It was found in the Cerro Gordo and Wild Rose districts.

Mono County: It occurs with tetrahedrite in the silver ores of the Blind Spring Hill district, Fairbanks (96a).

San Bernardino County: Stromeyerite occurred as one of the numerous minerals of the Calico district and an analysis of it from the Silver King mine was made by Melville and Lindgren (90).

Ag	Cu	Fe	S	Res = $BaSO_4 + SiO_2$	
53.96	28.58	0.26	15.51	1.55 = 99.86%	G. = 6.28.

Sierra County: A specimen of stromeyerite came from the Original 16-1 mine, Alleghany.

CUBANITE

Copper and iron sulphide, $CuFe_2S_3$.

Orthorhombic. Generally massive. Metallic luster. Color bronze-yellow. Streak black. H. = 3½. G. = 4.7.

Gives reactions similar to chalcopyrite.

Plumas County: Cubanite occurs with chalcopyrite and pyrrhotite in the Walker mine, 9 miles northeast of Spring Garden, Knopf (35).

San Luis Obispo County: A large mass of cubanite is said to have been found on Santa Rosa Creek, near San Simeon, Hanks (84).

SPHALERITE—Zincblende—Black Jack

Zinc sulphide, ZnS.

Isometric; hextetrahedral. Imperfect crystals, granular and massive. Cleavage perfect dodecahedral. Brittle. Resinous luster. Color yellow, brown, black. Streak colorless to yellowish-brown. H. = 3½ — 4. G. = 3.9 — 4.1.

A slight coating, yellowish while hot and whitish when cold, is obtained by intense heating. A few drops of cobalt nitrate added to the assay and intensely heated gives a yellowish-green color, which is characteristic of zinc minerals. Gives strong hydrogen sulphide odor when dissolved in hydrochloric acid.

Sphalerite is very common and is prevalent in most of the mining regions. It occurs from clear light-brown to very dark-brown, almost black masses. Its typical associate is galena, but it is also often intimately mixed with pyrite, chalcopyrite, tetrahedrite, arsenopyrite and lead-silver minerals. In the smelting of zinc-bearing ores few of the smelters have endeavored to save the zinc.

Alpine County: Sphalerite occurred as one of the minerals in the Uncle Billy Rogers claim, Hope Valley.

Calaveras County: It is common in the pyrite ore at Campo Seco and Copperopolis; with galena in the mines near Murphy; in the Washington mine, Indian Creek; with galena in auriferous quartz in

the Gold Nugget, Star of the West and other claims at Westpoint; in the Grasshopper, Comet, and Jones mines.

El Dorado County: It occurred in the mines at Grizzly Flats and Pilot Hill; with galena in the Mount Pleasant, Eagle King, Sun Dog, Flagstaff, Humphrey, and Grand Victory mines.

Fresno County: It was found in the Jumper Claim near Spanish Peak; with galena and quartz in the Luakala mine.

Humboldt County: It was found as float on Yager Creek.

Inyo County: It is common with galena in the Darwin, Cerro Gordo, and Inyo Mountain mines. It occurs in small amounts with the garnet and scheelite near Bishop.

Kern County: Very fine-grained masses of sphalerite occur in the Cinderella mine; with pyrite, pyrrhotite, and chalcopyrite near Lebec Post Office; and in the Urbana mine.

Los Angeles County: It occurs with galena and chalcopyrite on Santa Catalina Island.

Madera County: It occurred with galena in the McMurray and Homestake mines, Mount Raymond; in the Gambetta mine, Grub Gulch; at the Fine Gold Mine, Railroad Flat; with galena and chalcopyrite at the Nellie and Abbey mines, Hildreth district. Pale colored, resinous sphalerite is abundant on the north side of Shadow Creek in the Minaret mining district, Erwin (34).

Mariposa County: It occurs in the mines along the Mother Lode. A light-brown tribo-luminescent variety mixed with white barite and gray tetrahedrite, the ore resembling a dark-gray schist, was found at the Fitch mine and was described by Eakle (04) and Eakle and Sharwood (04). The sphalerite emits a peculiar train of light when scratched or rubbed. Light-yellow sphalerite occurs with galena at the Treasure mine, Quartzburg district; dark sphalerite with chalcopyrite on the Chowchilla River; with galena and quartz in the Bondurant mine.

Mono County: It occurs in the Homer, Lundy, and Benton districts. Massive black sphalerite with pyrite occurs at the Bunker Hill mine, Largo district; with galena in the White Mountains east of Benton.

Nevada County: Sphalerite occurs in many of the gold mines of this county. It is prominent in the Meadow Lake district and in the mines of Grass Valley and Nevada City.

Orange County: It occurs with galena in the Blue Light mine, Santiago Canyon.

Placer County: It was found in the gold ores at Ophir; with galena and pyrrhotite in the True Fissure mine; in the St. Lawrence and Bullion mines.

Plumas County: The mines of the Meadow Valley, Indian Valley and Light's Canyon contain some sphalerite with the other sulphides. Small crystals of sphalerite occur in the fine-grained quartz at Cronsberg; with galena and gold-bearing quartz in Granite Basin and in the Plumas Eureka mine. Small amounts of it occur with the copper ores at Engels.

Riverside County: Black sphalerite, some of it coated with yellow greenockite, occurs in the idocrase-garnet masses at Crestmore, Eakle (17).

Sacramento County: It occurs with galena at Michigan Bar.

San Bernardino County: Sphalerite is found with the silver-lead sulphides of the Silver Leaf, Calico, Grapevine, and Lava Beds districts. Perfect tetrahedral crystals of sphalerite were found in the Morongo district; also common in the New York mountains.

San Diego County: It occurs with pyrrhotite and pyrite near Fallbrook.

Santa Clara County: Sphalerite in quartz was reported from the Dennis Martin ranch, 4 miles west of Menlo Park.

Shasta County: Masses of sphalerite occur in the Rising Star, Afterthought, and Peck mines.

Sierra County: It occurs with galena, chalcopyrite, and arsenopyrite in the Alleghany district; in the Sierra Buttes mine, Kanaka mine, and in the Nixon Group, American Hill district.

Siskiyou County: It is common with galena and chalcopyrite at Callahan. It occurs with pyrite in gold quartz in the Grizzly Gulch mine, Indian Creek, and in the Hunter mine, Cherry Creek.

Trinity County: Small amounts of sphalerite occur with the ore at Island Mountain.

Tulare County: It is common in the Mineral King district.

Tuolumne County: Massive sphalerite was found at the Soulsby mine, and sparingly in the mines along the Mother Lode. It is associated with galena and occasionally with pyrrhotite at the Starr, Lost Fox, Keltz, Mary Ellen, Platt, Porto Fino, Pine Mountain, Louisiana, Mount Dana, Santa Maria, Black Oak, Sonnet, Draper, Densmore, and Carlotta mines.

METACINNABAR

Mercuric sulphide, HgS.

Isometric; hextetrahedral. Usually massive. Brittle; but sectile when massive. Metallic luster. Color grayish-black. Streak black. H. = 3. G. = 7.81.

Vaporizes with invisible fumes and gives a slight sulphur odor. Distinguished from cinnabar by its black color.

Colusa County: Metacinnabar was found with cinnabar and gold at the Manzanita mine in the Sulphur Creek district.

Contra Costa County: Metacinnabar is the principal ore mineral mined with subordinate cinnabar and stibnite to date (May, 1937) at the Mount Diablo mine (old Ryne).

Inyo County: It occurred in the Cerro Gordo mine and was analyzed by Melville and Lindgren (90).

HgS	FeS + SiO_2
95.62	4.38

Lake County: It was prominent in the Great Western, Baker, and Abbott mines; also found in the Bradford mine.

Monterey County: It occurs with the cinnabar in the Parkfield district.

Napa County: Metacinnabar was discovered in the Redington or Boston mine, Knoxville; also in the Ætna mine. It occurred in black seemingly amorphous masses and was described as a new mineral by G. E. Moore (70). Good crystals were later found in the same mine which showed the mineral to be isometric instead of amorphous, Penfield (85). Forms: (111), (211), (322), and (975). Analyses of metacinnabar from this mine were made by G. E. Moore (70) and also by Melville and Lindgren (90).

	S	Hg	Fe	SiO_2
Moore	13.82	85.79	0.39	0.25 = 100.25%
		HgS	FeS	SiO_2
Melville and Lindgren		98.48	0.69	0.71 = 99.88%

Metacinnabar was found coated with white calomel in the Oat Hill mine.

Orange County: Metacinnabar was found on the San Joaquin ranch disseminated through a ferruginous barite; analyzed by Genth (92).

Hg	S	Cl
85.89	13.69	0.32 = 99.90%

San Benito County: Large pieces of it have been found in the New Hope vein of the New Idria mine. It is found in black masses at the Picachos mine, Rogers (12).

San Luis Obispo County: It has been found in the Adelaide and Oceanic districts.

Santa Clara County: Considerable amounts of metacinnabar have been found in the New Almaden and Guadalupe mines. Melville (90) analyzed metacinnabar from the New Almaden mine and described the crystals as hexagonal, with some complex and doubtful forms. Analysis:

S	Hg	Fe	Co	Zn	Mn	$CaCO_3$	SiO_2	Vol. org. matter		
13.68	78.01	0.61	tr.	0.90	0.15	0.71	4.57	0.63	= 99.26%	G. = 7.1.

Solano County: It occurred with cinnabar in the Hastings mine near Benicia.

Sonoma County: Metacinnabar was found in the Culver-Baer mine, east of Cloverdale. Metacinnabar occurs abundantly with cinnabar, curtisite and realgar in sandstone at Skaggs Springs, Wright and Allen (30).

Yolo County: The ore of the California mine, later called Reed mine, was principally metacinnabar.

TIEMANNITE

Mercuric selenide, HgSe.

Isometric; hextetrahedral. Generally massive; compact. Brittle. Metallic luster. Color steel-gray to dark lead-gray. Streak black. H. = 2.3. G. = 8.19 — 8.47.

Gives the peculiar 'rotten-radish' odor of selenium when heated on charcoal. Reduces easily to metallic globules of mercury.

Lake County: According to W. P. Blake (66) tiemannite occurred in large masses near Clear Lake. Masses of it occurred in the Abbott mine associated with cinnabar and petroleum.

Orange County: It was found with cinnabar and metacinnabar at the San Joaquin Ranch mine.

Santa Clara County: It was found with cinnabar at the old Guadalupe mine near New Almaden.

COLORADOITE

Mercuric telluride, HgTe.

Isometric; hextetrahedral. Massive, granular. Octahedral cleavage. Metallic luster. Color iron-black. H. = 2½. G. = 8.07.

A white coating of telluric oxide and globules of mercury are obtained when roasted on charcoal. Gives the characteristic reaction for tellurium like tetradymite.

Tuolumne County: Hillebrand (99) found one specimen which he identified as coloradoite, associated with the other tellurides of the Norwegian mine near Tuttletown.

PENTLANDITE

Nickel and iron sulphide, (Fe,Ni)S.

Isometric. Massive, granular. Octahedral cleavage. Brittle. Metallic luster. Color light bronze-yellow. Streak light bronze-brown. H. = $3\frac{1}{2}$ — 4. G. = 5.0.

Fuses easily, yielding a magnetic globule. Soluble in nitric acid.

San Diego County: Hudson (22) has reported the probable occurrence of pentlandite with pyrrhotite and chalcopyrite in the nickel ore of the Friday mine near Julian.

CINNABAR

Mercuric sulphide, HgS.

Hexagonal-rhombohedral. Small crystals common; also granular massive. Cleavage perfect prismatic. Adamantine luster. Color cochineal-red. Streak scarlet. H. = 2 — $2\frac{1}{2}$. G. = 8.0 — 8.2.

Volatilizes completely and yields a slight sulphur odor on heating before the blowpipe.

Cinnabar was known in the State long before the discovery of gold, and the old mine at New Almaden had been in active operation for some time when Lyman (48) described a visit to it in 1848. The most important deposits lie in the Coast Ranges extending from Del Norte County to San Diego County. Those in the Sierra Nevada are of minor value. Lake, Napa, Santa Clara and San Benito counties have been most important in the mining of cinnabar.

The quicksilver deposits of California have been described in Monograph XIII of the United States Geological Survey, Becker (88) and Bulletin No. 78 of the State Division of Mines, W. W. Bradley (18).

Alameda County: Streaks of cinnabar occur in a chalcedonic mass in the Cragmont district, North Berkeley.

Calaveras County: A small amount of cinnabar with quartz has been found in the Blue Wing mine, north of Murphy.

Colusa County: Deposits of cinnabar occurred on both sides of Sulphur Creek in sandstones and shales, associated with sulphur, bitumen, and gold, Fairbanks (94). The Manzanita, Elgin, Empire, and Wide Awake mines were former producers. The Manzanita mine was noted for its occurrence of gold with cinnabar.

Contra Costa County: A deposit of cinnabar was found in serpentine on the eastern slope of the North Peak of Mount Diablo, where recent operations have yielded commercial production, principally from metacinnabar.

Del Norte County: Cinnabar is found in the northern part of the county in the Diamond Creek district.

El Dorado County: The Bernard or old Amador quicksilver mine on Fanny Creek, 2 miles west of Nashville and about 8 miles from Shingle Springs, in slates and quartzites, has produced cinnabar.

Fresno County: Cinnabar occurs in the Little Panoche district on the Gabilan Range and on Cantua Creek. The Mexican mine, about 9 miles southeast of New Idria, was an early producer.

Glenn County: It has been reported on the Nye ranch, southwest of Fruto, and on the Turner ranch, west of Elk Creek.

Humboldt County: A small deposit of cinnabar occurs near Orleans Bar.

Inyo County: Small amounts of cinnabar occurred at the Cerro Gordo mines. It is found in the Chloride Cliff mine in the Funeral Mountains west of Rhyolite; also at Coso Hot Springs.

Kern County: Cinnabar occurs in a porous porphyritic rhyolite at the Cuddeback cinnabar mine, 3 miles from Woodford, Bradley (18). Cinnabar has been observed about 2½ miles west of Cinco and 20 miles from Mojave.

Kings County: Small deposits of cinnabar occur on Table Mountain in the southern part of the county, and the Kings mine has native mercury associated with the cinnabar. It occurs in serpentine, shale and metamorphosed sandstone.

Lake County: The important and interesting deposit of cinnabar at Sulphur Bank on the shore of Clear Lake has been described at length by Becker (88) and by Le Conte and Rising (82). Cinnabar is at present in process of formation in the porous disintegrated basalt which outcrops on the lake. Crystals of cinnabar are long hexagonal prisms capped by the low rhombohedron $(20\bar{2}3)$. Melville and Lindgren (90) gave the forms $(30\bar{3}4$ and $(0\bar{3}34)$. The Great Western, Baker, Helen, Wall Street, and Mirabel mines a few miles from Middletown were famous producers.

Marin County: Streaks of cinnabar have been observed in the rock near Point Reyes.

Mariposa County: Crystals of cinnabar are said to have occurred near Coulterville associated with gold, in a quartz ledge on the Merced River.

Mendocino County: A small deposit of it occurs at the Occident mine, 7 miles southwest of Hopland.

Modoc County: A cinnabar deposit occurs 3½ miles southeast of Willow Ranch Station, close to the county road. Cinnabar has been reported 25 miles southeast of Cedarville.

Mono County: Cinnabar occurs with calcite and native mercury 5 miles northeast of Bodie.

Monterey County: Some of the deposits of cinnabar on Table Mountain near Parkfield are in this county. The Patriquin or Parkfield mine has been the chief producer.

Napa County: This county has long been an important producer of mercury, the mine at Oat Hill being among the best known. The cinnabar is found impregnating unaltered sandstone. The abandoned old Redington or Boston mine at Knoxville is famous for the rare and new minerals found with the cinnabar. Much of the cinnabar of this region impregnates shattered chalcedony masses in the serpentine, as at the Manhattan mine, and some impregnates the serpentine. Cinnabar crystals from the Redington mine with the forms (10$\bar{1}$0), and (04$\bar{4}$5) were reported by G. E. Moore (70) and Bertrand (78). Deposits of it in Pope Valley have also been important; also the Aetna mine.

Nevada County: It occurs with gold at Grass Valley, W. P. Blake (66), Lindgren (96). It is scattered through quartzose and dolomite gangue on contact of serpentine and quartzite on Nickerson ranch, in the southern part of the county.

Orange County: A small deposit of it occurs on the San Joaquin ranch, near Tustin.

San Benito County: The mines in the New Idria district, in the southern part of the county, are second only to New Almaden in total production to date. Smaller deposits of cinnabar occur near the center of the county and in the extreme northeastern part of the county. Melville and Lindgren (90) describe crystals from the New Idria mine with the forms: (0001), (02$\bar{2}$3), (01$\bar{1}$2), (01$\bar{1}$1), (20$\bar{2}$3), (10$\bar{1}$2), (10$\bar{1}$0), (6.4.$\overline{10}$.25), (5.2.$\bar{7}$.18), (105.60.$\overline{165}$.407), (63.27.$\overline{90}$.230), (40.15.$\overline{55}$.143), and (26.12.$\overline{38}$.95). Cinnabar occurs with stibnite at the Stayton, French, and Florence mines.

San Bernardino County: Deposits of it occur 9 miles northeast of Danby in a breccia. Cinnabar occurs as inclusions in bluish-gray chalcedony in the southern end of Death Valley, 15 miles northeast of Lead Pipe Springs and 45 miles northeast of Johannesburg, and colors the chalcedony with reddish blotches and streaks, forming the gem stone known as 'myrickite.' It occurs with wolframite in Clark Mountain, near Ivanpah. Cinnabar was found on City Creek, 6 miles from San Bernardino.

San Francisco County: Small streaks of cinnabar occur on Twin Peaks.

San Luis Obispo County: The productive mines occur in the Santa Lucia Range, and comprise several districts of which the Oceanic, Klau, and Cambria are the most important. Cinnabar impregnates the Franciscan sandstones and shales and also chalcedonic masses in the serpentine. There are numerous small deposits in outlying districts.

San Mateo County: Cinnabar occurs on the Corte de Madera Rancho near Searsville, west of Palo Alto. Small stringers of cinnabar occur in the serpentine just west of San Mateo.

Santa Barbara County: Cinnabar occurs in the Santa Ynez Range and near Acachuma Creek. The Acachuma, Los Prietos, and Santa Rosa mines have produced some quicksilver.

Santa Clara County: Cinnabar was mentioned by W. P. Blake (58) as occurring at the New Almaden mine, the oldest quicksilver mine in the State. It has been a famous producer and is still yielding some quicksilver. The cinnabar of the district occurs impregnating in streaks the opal-like masses of silica formed by the alteration of the serpentine. Melville and Lindgren (90) described crystals from the mine with forms: (0001), $(01\bar{1}2)$, $(02\bar{2}3)$, $(02\bar{2}1)$, $(10\bar{1}0)$, and $(0.14.\overline{14}.5)$. It is also abundant at the Guadalupe, Senator and other mines in this district.

Shasta County: Cinnabar is found about 30 miles northeast of Redding, and at the Clover Creek mine.

Siskiyou County: Cinnabar occurs with native mercury at the Mercury mine, near Gottville, Averill (31).

Solano County: The old St. John mine, about 6 miles northeast of Vallejo, was a good producer in the early days of cinnabar mining. It also occurred with metacinnabar in the Hastings mine near Benicia.

Sonoma County: Most of the mines which were once productive occur in the Mayacmas district, along the Mayacmas Range. Cinnabar in fine crystals occurs with native mercury and metacinnabar in the Culver-Baer mine. Crystals from the Great Eastern mine were reported by Sachs (07) to be columnar with the forms $(10\bar{1}0)$ and $(20\bar{2}1)$. Cinnabar was found at Skaggs Springs with metacinnabar.

Stanislaus County: Cinnabar deposits occur on Red Mountain on the border of Santa Clara County.

Trinity County: The old Altoona and other claims in the northern part of the county, near Cinnabar and Carrville, have been productive in a small way for many years.

Tuolumne County: Small crystals and grains of cinnabar occur at Marshs Flat and on the slope of the ridge east of Horseshoe Bend.

Yolo County: The deposits of this county are in the continuation of the Knoxville district. In the Reed mine, originally called the California mine, cinnabar occurs with metacinnabar which is the chief ore mineral.

GREENOCKITE

Cadmium sulphide, CdS.

Hexagonal. Generally as thin coatings. Cleavage $(11\bar{2}0)$ distinct. Brittle. Adamantine to resinous luster. Color and streak orange-yellow. H. = 3 — 3½. G. = 4.9 — 5.0.

Mixed with sodium carbonate and heated on charcoal, a coating is obtained which is reddish-brown near the assay and yellow beyond. Soluble in hydrochloric acid.

A very rare mineral occasionally found coating sphalerite.

Inyo County: Prismatic crystals of greenockite occur with limonite and hemimorphite in a quartz vein in the Cerro Gordo mine.

Mono County: Thin coatings of *xanthocroite*, amorphous CdS, occur on magnetite and sphalerite near Topaz.

Riverside County: Thin coatings of greenockite were found on sphalerite in the limestone quarry at Crestmore.

Shasta County: Greenockite occurs in the copper-zinc ores of this county and the Mammoth Copper Company has recovered cadmium in its electrolytic zinc plant.

MILLERITE

Nickel sulphide, NiS.

Hexagonal-rhombohedral. Usually in long slender needles and hair-like tufts. Cleavage perfect prismatic. Brittle. Metallic luster. Color brass-yellow. Streak greenish-black. H. = 3 — 3½. G. = 5.3 — 5.65.

Roasted on charcoal, it yields a slight odor of sulphur and leaves a magnetic residue. The roasted residue fused in a bead of borax, will give a brown bead, which becomes gray and cloudy, when reduced. Produces a pale-blue solution when dissolved in nitric acid and ammonia added.

Calaveras County: Long divergent prisms of millerite, which Jackson (86) thought to be elongated cubes of pyrite, were found in white albite at the Stanislaus mine on Carson Hill.

Humboldt County: Specimens of serpentine from this county occasionally contain needles of millerite.

Napa County: Small coatings of millerite were found with cinnabar at the Andalusia mine near Knoxville; also at the Oat Hill mine in Pope Valley. Specimens of serpentine containing needles of millerite have come from Berryessa Valley.

Placer County: It was found with arsenopyrite near Cisco, Hanks (84).

Plumas County: Millerite occurred as coatings in the Pocahontas mine, Mount Meadow district.

PYRRHOTITE—Magnetic Pyrites

Ferrous sulphide, Fe_nS_{n+1}.

Hexagonal. Crystals rare. Commonly massive, either granular or compact. Brittle. Metallic luster. Color bronze-brown. Streak grayish-black. H. = $3\frac{1}{2}$ — $4\frac{1}{2}$. G. = 4.58 — 4.64.

Usually magnetic, becoming more strongly so on heating. Dissolves in hydrochloric acid with evolution of hydrogen sulphide.

Pyrrhotite is often associated with pyrite and sometimes is found in large lenticular masses. It is a common sulphide in gold and copper districts, although generally in small amounts. Masses of it occur in serpentine and in pegmatite veins. It is sometimes nickeliferous.

Amador County: Pyrrhotite occurs in albite veinlets at the Treasure mine near Amador City, Knopf (29).

Calaveras County: It is occasionally found with the pyrite at Campo Seco, Copperopolis and at Westpoint. It occurs disseminated in diorite at the Easy Bird mine northeast of Mokelumne Hill, a few miles east of the Mother Lode belt, Knopf (29).

Del Norte County: It was found with chalcopyrite at the copper claims on Diamond Creek, Copper Creek, and Shelly Creek; with chalcopyrite and pyrite in the Angora mine, Preston Peak, and at French Hill.

El Dorado County: Pyrrhotite occurs with sphalerite and chalcopyrite in auriferous quartz near Diamond Springs; massive with chalcopyrite at the Noonday mine; in large masses with chalcopyrite and pyrite at the Alabaster Cave mine, Pilot Hill.

Fresno County: Large bodies of pyrrhotite are reported to occur on the Fresno Copper Company's property.

Humboldt County: Bodies of pyrrhotite are reported to occur on Elk Creek.

Inyo County: It occurs with chalcopyrite and pyrite at Marble Canyon.

Lake County: It was found on the Langtry ranch, 7 miles south of Middletown.

Madera County: It was found in the old Buchanan mine, Turner (96). Intimate mixtures of pyrrhotite, sphalerite, pyrite and chalcopyrite occur in the Mount Raymond district. Massive pyrrhotite containing thin seams of chalcopyrite in chlorite and actinolite occurs at the Heiskell mine in the Minaret district. Large masses of pyrrhotite

reported to carry several per cent of cobalt and nickel occur about 12 miles northeast of Madera.

Marin County: Tabular crystals have been found on Mount Tamalpais.

Mariposa County: Thick bodies of pyrrhotite occur in the Green Mountain mine. It occurs abundantly in the ore at the Croesus prospect on the Merced River, 2 miles north of Bagby, Knopf (29).

Mono County: It is common in quartz at the Tioga mine, Turner (94).

Nevada County: Pyrrhotite was found in the mines of Grass Valley and Nevada City, Lindgren (96). It was also found in the Meadow Lake district, Lindgren (93). It occurred massive at the Yuba mine, Washington district; also at Spenceville.

Placer County: It was reported from the Ophir mine, Lindgren (94). It occurred with galena and sphalerite in quartz at the True Fissure mine, Devils Peak Mountain.

Plumas County: Pyrrhotite occurs in masses between sandstone and serpentine about 1½ miles south of Taylorsville, Diller (08); it is intimately mixed with chalcopyrite at the Reward and Beckwith mines.

San Diego County: A large body of nickel-bearing pyrrhotite associated with chalcopyrite, pyrite, and polydymite occurs on contact of gabbro and fine-grained mica schist, at the Friday copper mine, Julian district, Calkins (16a), Hudson (22).

Shasta County: It was found with the pyrite at some of the copper mines and noticed at the Black Diamond copper mine and Sutro mines; also carrying nickel on the Jennings property near Hirtz Mountain.

Sierra County: It occurred with chalcopyrite at the Lost Cabin prospect.

Siskiyou County: It is prominent with chalcopyrite at Callahan. It is said to be nickeliferous at the Hummer mine; with chalcopyrite at the Bonanza mine, near Honolulu; at the Carlson mine, Dutch Creek; with galena in quartz at the Siskiyou mine, at the head of White Gulch.

Trinity County: A large mass of pyrrhotite associated with chalcopyrite occurs at Island Mountain on the South Fork of Eel River.

Tuolumne County: Pyrrhotite occurs in gneiss on the North Fork of Beaver River, Turner (02). It occurs with sphalerite and galena at the Soulsby mine; with galena and sphalerite in quartz at the Montgomery, Cherokee, Carlotta, Densmore, Draper, and Louisiana mines.

TROILITE

Ferrous sulphide, FeS.

Hexagonal. Massive. Compact granular. Metallic luster. Color light grayish-brown. Speedily tarnishes to bronze-brown. Streak black. H. = $3\frac{1}{2} - 4\frac{1}{2}$. G. = 4.67 — 4.82.

Fuses to a black magnetic mass. Easily soluble in dilute sulphuric acid and generates strong hydrogen sulphide fumes and odor.

Del Norte County: Troilite was found massive in a sheared zone of serpentine, in a copper claim, northeast of Crescent City. It was analyzed and described by Eakle (22). Analysis of the soluble portion gave:

	Fe	S
1.	58.78	33.62
2.	62.70	35.40

It contains inclusions of magnetite from which it has probably been derived. This is the only known terrestrial occurrence of troilite. It had been observed previously in meteorites.

COVELLITE

Cupric sulphide, CuS.

Hexagonal. Commonly massive. Cleavage basal. Submetallic to resinous luster. Color indigo-blue. Streak grayish-black. H. = $1\frac{1}{2} - 2$. G. = 4.6.

Gives a stronger odor of sulphur than is obtained from chalcocite, otherwise the reactions are the same. Distinguished by color.

Covellite is much rarer than chalcocite. It is usually associated with bornite, chalcocite or chalcopyrite.

Calaveras County: Covellite has been found at the Satellite mine near Campo Seco. Rogers (11) mentions specimens of covellite from the Poole mine at Nassau and from a prospect between Nassau and Copperopolis in which covellite formed by replacement of sphalerite.

El Dorado County: It occurred with chalcopyrite in the Rose Kimberley and Boneset mines.

Humboldt County: Covellite has been found on Horse Mountain.

Inyo County: Covellite occurs as veinlets in sphalerite and blebs in galena in the mines of the Panamint district, Murphy (30a).

Madera County: It was found at the old Pocahontas mine.

Mariposa County: Small amounts of covellite have been found in the Copper Queen mine near Mariposa.

Napa County: It occurred with chalcocite and malachite at the Juniper mine.

Plumas County: It occurs as a marginal replacement of bornite and chalcopyrite at Engels.

Shasta County: Covellite occurs in the Balaklala mine, and at the Bully Hill mine as an alteration of chalcopyrite, Rogers (11). Covellite is found as a coating on pyrite at the Mountain Monarch prospect 2 miles south of Whiskeytown, Ferguson (14).

Sierra County: It was found at the Black Jack mine, Kanaka Creek.

Siskiyou County: It occurred with bornite and chalcopyrite at the Copper King Mine, Blue Ledge mining district.

BORNITE—Erubescite—Peacock Ore

A sulphide of copper and iron, Cu_5FeS_4.

Isometric. Crystals very rare. Generally compact massive. Metallic luster. Color reddish-brown, generally tarnished to iridescent colors. Streak grayish-black. H. = 3. G. = 4.9 — 5.4.

Reduced on charcoal with sodium carbonate, it yields globules of metallic copper and a magnetic residue. Dissolved in nitric acid and ammonia added, much ferric hydrate is precipitated, while the solution becomes blue.

Bornite is generally associated with chalcocite and chalcopyrite, and is found in small masses in many of the copper districts. It is sometimes formed along contact zones with garnet, epidote and idocrase. The reddish-brown color and characteristic tarnish to peacock colors readily distinguishes bornite from grayish-black chalcocite and brass-yellow chalcopyrite.

Calaveras County: Small masses of bornite have been found at Campo Seco and Copperopolis.

Del Norte County: It is common in the mines at the head of Copper Creek. It was found with enargite at French Hill.

El Dorado County: It occurred at Slug Gulch with chalcopyrite and massive green epidote. In the old Cosumnes copper mine, near Fairplay, massive bornite occurred in coarse pegmatite of orthoclase, hornblende, epidote, garnet, and molybdenite. It was found at Georgetown with massive garnet. Small amounts of bornite were found in the Alabaster Cave mine near Pilot Hill with chalcopyrite, azurite, and malachite.

Fresno County: It occurs with magnetite and free gold in the Uncle Sam mine, on Crown Creek, near Tehipite Dome, Bradley (16a).

Inyo County: It is found in some of the mines of the Inyo and Ubehebe Mountains.

Kern County: It occurs at the Greenback mine, Woody copper district, Storms (13).

Lassen County: Bornite occurs disseminated in a pegmatite vein 3 miles west of Buntingville.

Los Angeles County: It was found in the Meadow Valley district with fine crystals of garnet.

Madera County: It is found at the Bliss and Nidever claims in the Minaret district, Erwin (34).

Mono County: It occurred in the Tioga mine and in the Benton district.

Plumas County: Bornite occurs with chalcopyrite at the Engel mine, Knopf and Anderson (30) and with chalcopyrite, tetrahedrite and tourmaline at the Superior mine, Anderson (31).

Riverside County: Bornite has been found in the Commercial Rock quarry at Crestmore, Eakle (17).

San Bernardino County: Bornite occurs at the Tiptop mine, Lava Beds district. It was found with chalcocite in the Francis Copper mine, Kelso district, Providence Mountains.

Santa Clara County: It was found near Lexington, Hanks (84).

Shasta County: Bornite is occasionally found in the copper mines of this county and specimens have come from Bully Hill, Copper City, Afterthought, and Iron Mountain.

Trinity County: It occurs with pyrrhotite at Island Mountain.

Tulare County: It is found with chalcopyrite at the Hart prospects 12 miles east of Badger, Franke (30a).

VIOLARITE

A sulphide of nickel and iron, $(Ni,Fe)_3S_4$.

Isometric. Crystals and massive. Perfect cubic cleavage. Metallic luster. Color steel-gray. H. = 4½. G. = 4.5 — 5.

Becomes magnetic on heating and gives off sulphur odor. Soluble in nitric acid, giving green solution, which turns blue on the addition of ammonia.

San Diego County: Violarite occurs with pyrrhotite and chalcopyrite in the nickel ores of the Friday mine at Julian, Short and Shannon (30).

CHALCOPYRITE—Copper Pyrites

A sulphide of copper and iron, $CuFeS_2$.

Tetragonal; scalenohedral. Generally massive. Metallic luster. Color deep brass-yellow, often with iridescent tarnish. Streak greenish-black. H. = 3½ — 4. G. = 4.1 — 4.3.

Fusible and soluble. Ammonia added to a nitric acid solution precipitates reddish ferric hydrate and turns solution blue. Becomes magnetic after roasting and small globules of copper are obtained by reduction with soda. Distinguished from pyrite by deeper color and presence of copper; from bornite by its brass color; and from gold by its ready solubility in nitric acid.

Chalcopyrite is the commonest of the copper minerals, and forms the principal source of copper in the State. The copper deposits are

largely bodies of pyrite in which chalcopyrite is intermingled. Most of the deposits have a capping of earthy limonite and hematite resulting from the oxidation of the iron sulphides. Practically all of the large bodies of pyrite in the State carry some chalcopyrite, but those in Shasta, Plumas, and Calaveras counties have been most important in the production of copper. Chalcopyrite in small patches and seams has a wide distribution, and in consequence of its alteration, green stains and coatings of copper carbonate are common. A general report on the copper resources of the State is contained in Bulletin No. 50 of the State Division of Mines.

Alameda County: A body of pyrite containing a small amount of chalcopyrite was mined at Leona Heights, East Oakland, Schaller (03).

Alpine County: Chalcopyrite occurs with the pyrite and enargite in the Mogul district.

Amador County: Chalcopyrite was the chief ore mineral in the Newton mine near Ranlett and in the Copper Hill mine. Chalcopyrite has been found in the gold ores of the Argonaut mine, Jullum (32).

Butte County: It occurs near Bangor; with quartz, chalcocite, and gold on Berry Creek.

Calaveras County: Chalcopyrite was the chief ore mineral in the copper mines near Copperopolis and Campo Seco.

Contra Costa County: Chalcopyrite occurs with gold and bornite at a prospect in a ravine tributary to Mitchell Canyon on Mount Diablo, Turner (91).

Del Norte County: Deposits of chalcopyrite with pyrite and pyrrhotite occur at Low Divide, Diamond Creek and Shelly Creek, in the serpentine area of the northern portion of the county near Smith River and its tributaries.

El Dorado County: Good specimens of chalcopyrite with bornite, molybdenite, garnet, epidote, and axinite have come from the old Cosumnes copper mine on the Amador County line. Chalcopyrite occurs in small amounts in a hornblende schist near Rescue; with pyrrhotite and pyrite at the Noonday mine; in gold-bearing quartz with galena at the Rose Kimberley mine; with malachite, azurite, and native copper at the Cambrian mine, 13 miles northwest of Placerville; in an amphibole schist at the Copper Lead mine, Martinos Creek; at the Pyramid and Boneset mines near Shingle Springs; with galena, magnetite, calcite, quartz, and garnet in the Lilyoma mine and in the Pioneer mine, Pilot Hill; with bornite, azurite, and malachite at the Alabaster Cave mine, Pilot Hill; with chalcocite in serpentine at the Boston mine, Latrobe.

Fresno County: Chalcopyrite occurs with pyrrhotite at the Fresno copper mines; with pyrite at the Copper King mine; and in the gold district of the northeastern part of the county.

Humboldt County: Deposits of chalcopyrite occur on the eastern slope of Horse Mountain with chalcocite, native copper, and cuprite. It was found in small amounts near Trinidad, on the seacoast, and sparingly on Red Cap Creek.

Imperial County: The copper claims near Ogilby, Hedges, and in the Picacho district contain some chalcopyrite with oxidized ores.

Inyo County: Chalcopyrite occurs near Darwin at contact of granite and limestone and in the Ubehebe Mountains with chalcocite. It occurs with galena, cerusite, and native copper in limestone at Chloride Cliff, Grapevine Range; at contact of limestone and diorite at Gold Belt in the Panamint Range; with pyrrhotite, bornite, and pyrite in Marble Canyon, 25 miles east of Big Pine; in garnet rock in Mazourka Canyon; as banded masses with galena at the Custer mine; with gold quartz at the Golden Treasure mine; in the Argus Range; with galena and pyrite 5 miles southeast of Keeler. It was found at the Wilshire gold mine, 25 miles southwest of Laws, Turner (22).

Kern County: Chalcopyrite occurs with pyrite in the gold mines of the eastern part of the county near Randsburg and Garlock; with sphalerite and pyrrhotite near Lebec; with wolframite near Woody. It was found at the Greenback Copper mine, 18 miles east of Jasmin, Turner (02a).

Lake County: Chalcopyrite occurred with pyrrhotite on the Langtry ranch, 7 miles south of Middletown.

Los Angeles County: It occurs intimately mixed with pyrrhotite near San Fernando; with pyrite and malachite, 2 miles north of Camp Rincon, San Gabriel Canyon.

Madera County: It is found in small masses at the old Buchanan mine, at the Ne Plus Ultra and other claims near Daulton. It occurs as thin seams in massive pyrrhotite in chlorite and actinolite at the Heiskell mine; with sphalerite in quartz in the Nellie mine, Hildreth; in intimate mixture with sphalerite and pyrrhotite at the Matilda and Best Chance mines, Minaret district.

Marin County: Small deposits of pyrite mixed with chalcopyrite occur in the schists between Mount Tamalpais and Bolinas Bay. A small deposit occurred about 1 mile east of Woodville and north of Bolinas.

Mariposa County: The Green Mountain Copper Group 8 miles northwest of Raymond, the old Pocahontas mine near Lewis, the Copper Hill mines in Indian Gulch, the old Beretta mines and other claims near the Merced River, contain massive chalcopyrite with auriferous pyrite. It occurs with tetrahedrite at the Bunker Hill mine; with pyrite and arsenopyrite at Hornitos; at the Peterson, Comet, White Rock, and Donaway mines.

Mendocino County: It occurs with malachite in small quartz veins at the Eden Valley mine and in the Red Mountain district.

Napa County: It was found in the gold-silver ores of the Palisades mine, 2 miles north of Calistoga.

Nevada County: Chalcopyrite claims have been worked at Spenceville, Mineral Hill, Pine Hill, Iron Mountain, French Corral, and North San Juan. Good masses of pure chalcopyrite are found in the Meadow Lake district. It occurs with pyrite in quartz veins in the schists extending from Birchville northward to Bullard's Bar, Sierra County.

Placer County: Chalcopyrite occurs with pyrite near Auburn, Newcastle, Valley View, and at Dairy Farm.

Plumas County: Chalcopyrite is one of the principal ore minerals at the Walker mine and at the Engels and Superior mines, Anderson (31), which have been the leading copper producers in the State since 1915.

Riverside County: Chalcopyrite occurs in copper prospects in the Palen and McCoy mountains. It is common in the auriferous quartz veins of the Monte Negro district. It occurs with pyrite and galena at the Crestmore limestone quarry, Eakle (17).

San Benito County: It occurs in small amounts on Lewis Creek.

San Bernardino County: Chalcopyrite occurs with oxidized copper ores on Clark Mountain, in the New York Mountains, near Ivanpah, Manvel, Vontrigger, Sunrise, Needles, on Mount Whipple, Monument Mountain, Turtle Mountain, and in the Providence Mountains. It is found in the Lava Beds district, in the Oro Grande district, and in the Morrow district north of Barstow. It occurs in limestone at the Three States mine, Silver Lake district. Large specimens of chalcopyrite have come from the Kingston Range. It is found with specular hematite, quartz and pyrite in the Bullion district. It occurs with galena, argentite and pyrite in the Goldstone district. It was found in a quartz vein with sphalerite, galena, and wolframite at the Sagamore mine, New York Mountains.

San Diego County: Masses of chalcopyrite occur in the Encinitas group of mines, a few miles east of Encinitas and in the Banna mines near Lakeside. It was found in the Julian district, Calkins (16a), Hudson (22). It was found in gold-bearing quartz veins on Barker Mountain.

San Luis Obispo County: It was observed at Cambria.

Santa Barbara County: It occurs with quartz in shale at several points along the southern slope of the San Rafael Mountains, northeast of Los Olivos.

Shasta County: Chalcopyrite was the principal ore mineral in the Shasta County copper belt which included the Iron Mountain, Shasta King, Balaklala, Golinsky, Mammoth, Afterthought, Copper City and Bully Hill mines.

Sierra County: Small masses of chalcopyrite with other sulphides occur near Poker Flat, Sierra City and in the Mohawk Valley. It occurred at the Black Jack mine, Kanaka Creek; at Four Hills, Sierra City district; in the Alaska mine and the Gold Canyon mine, Alleghany district.

Siskiyou County: The Richie mine and claims near Callahan show chalcopyrite. It occurred at the Dewey and Oak Hollow mines, Happy Camp; in the Buckeye district; at the Hunter mine, Cherry Creek; massive fine-grained about 4 miles southeast of Fort Jones; at the Yellow Butte mine, Weed; massive mixed with pyrrhotite and pyrite at the Carlson mine, Dutch Creek; in quartz at the New York Gulch mine, Indian Creek; at the Blue Ledge mine, Elliot district; at the Apex mine, head of Cottonwood Creek; with pyrrhotite in schist on the South Fork of Salmon River and on Preston Peak; at the Maryland mine, Quartz Valley; at the Bonanza mine near Honolulu; mixed with pyrrhotite 8 miles east of Callahan; at the Doolittle and Gazelle mines.

Sonoma County: Chalcopyrite occurs in small crystals with malachite and azurite at the Sonoma Copper mine, half a mile east of Tyrone; with pyrite on Black Mountain; in the Cornucopia mine, 14 miles northeast of Cloverdale; in the Grizzly mine, 18 miles northeast of Healdsburg.

Tehama County: It was found 5 miles northwest of Paskenta; with pyrite on the northern slope of Tom Hood Mountain, 40 miles west of Red Bluff.

Trinity County: Deposits of chalcopyrite occur in the western part of the county along New River, at the mouth of Rattlesnake Creek and on the Cold Fork of Indian Valley Creek; in the Copper Queen

and Headlight mines, Carrville district; with pyrite in schists near Ruth; in the quartz of the Gambrinius and Craig gold mines; at the Bear Tooth mine, New River district; near Zenia; with pyrrhotite at Island Mountain.

Tulare County: Chalcopyrite with pyrite is found on the Middle Fork of Tule River, a few miles east of Porterville and near Kearsarge Peak.

Tuolumne County: Masses of chalcopyrite occur with pyrite in quartz at the Union, Conrad and Society mines, Big Oak Flat; with other sulphides at the Keltz mine, 10 miles north of Soulsbyville; in auriferous quartz at the Black Oak mine, Soulsbyville; at Chinese Camp; near Rawhide; at the Experimental mine, 2 miles northwest of Columbia; at the Mann Copper mine, 3 miles south of Jamestown; at the Golden Gate mine near Sonora; at the Greenstone, San Guiseppe, Mount Dana, Platt and Golden Treasure mines.

Yuba County: It occurs in auriferous quartz in the Brownsville district, in the Golden Mary mine; in the Ayer mine, 4 miles west of Smartsville.

PYRITE—Iron Pyrites

Iron disulphide, FeS_2.

Isometric; diploidal. Crystals common; usually cubes, pyritohedrons and octahedrons. Generally compact and granular massive. Brittle. Metallic luster. Color brass-yellow. Streak greenish-black. $H. = 6 - 6\frac{1}{2}$. $G. = 5$.

Easily fusible. Roasted on charcoal, it burns with a blue flame and gives a strong sulphur odor. The residue becomes magnetic. Soluble in nitric acid and reddish ferric hydrate is precipitated by ammonia.

Pyrite is the commonest of the sulphide minerals and is found in all kinds of rock, but is especially prominent in metamorphic schists, slates, and quartzites, and in unaltered sandstones. It is commonly found in distinct crystals and in granular masses. Cubes several inches in diameter are frequent in gold districts, but in general the smaller crystals and granular masses are more highly auriferous. All of the localities given for chalcopyrite, and many more, might be cited for pyrite since it is present in every county. The oxidation of pyrite produces limonite and hematite, and the 'gossan' of mineral veins is mostly formed by its alteration. Cubes of limonite as pseudomorphs after pyrite are exceedingly common.

Alameda County: Crystals from the Alma mine, Leona Heights, have the forms: (110), (100), (340), (120), (140), (111), (252), (121), (241), and (231), Schaller (03).

Calaveras County: Cubes and pyritohedrons occur with the gold on Carson Hill, but the long needles from the Stanislaus mine, described as distorted pyrite crystals by Jackson (86) are millerite. Good cubes are found at Murphy in the Masonia mine.

Colusa County: Hexagonal plates of pyrite occur as pseudomorphs after pyrrhotite at the Sulphur Creek deposit, Genth (87).

Mendocino County: A large deposit of pyrite carrying chalcopyrite occurs in Anderson Valley.

Riverside County: Pyrite is present in the Crestmore limestone as grains, cubes and pyritohedrons; some of the crystals are large. Limonite pseudomorphs after the pyrite are common.

Santa Clara County: Crystals from the New Almaden cinnabar mine had the forms: (100) and (470), Jackson (86).

Shasta County: It was found by Day and Allen (25) in the hot springs and mud pots of Lassen Volcanic National Park. Pyrite used for sulphuric acid occurs in commercial quantities and is produced at the Hornet mine in the NE. ¼ of Sec. 34, T. 33 N., R. 6 W., M. D. M.

Sonoma County: Large octahedrons have been found on Austin Creek, near Healdsburg.

Trinity County: It occurs with pyrrhotite at Island Mountain.

Tuolumne County: Small cubes are common at the Norwegian mine.

COBALTITE

Sulpharsenide of cobalt, CoAsS.

Isometric. Commonly in cubes and pyritohedrons; also massive. Cleavage perfect cubic. Metallic luster. Color reddish-white. Streak grayish-black. H. = 5½. G. = 6 — 6.3.

On charcoal it gives sulphur odor and white coating of arsenic oxide when roasted. The residue becomes magnetic. Borax bead of the roasted material is cobalt blue. Ammonia colors a nitric acid solution of cobaltite pink.

Mariposa County: Good cobaltite crystals were found in the Copper Chieftain mine.

Mono County: It occurred with gold in the Tioga mine, Turner (94).

Nevada County: Small seams of cobaltite with chalcopyrite occur in a schist on Rattlesnake Creek, south of Signal Peak.

Placer County: It was found with arsenopyrite in the Metallic mine, near Cisco; with chalcopyrite about 4 miles northeast of Alta.

SMALTITE

Cobalt arsenide, $CoAs_2$.

Isometric; diploidal. Generally massive. Brittle. Metallic luster. Color tin-white. Streak grayish-black. H. = 5½ — 6. G. = 5.9 — 6.8.

The roasted mineral becomes magnetic. Gives a white coating of arsenic trioxide on charcoal. A cobalt-blue bead of borax is obtained, using the roasted mineral.

Calaveras County: Smaltite has been found with erythrite in a small stringer at the Mar John mine near Sheepranch, Logan (24).

Los Angeles County: Smaltite coated with erythrite occurred with the native silver and argentite at the old Kelsey and O. K. mines near San Gabriel Canyon.

Napa County: Smaltite has been found in thin seams with erythrite in the serpentine rock of Berryessa Valley.

Nevada County: It occurs in the Meadow Lake district.

MARCASITE

Iron disulphide, FeS_2.

Orthorhombic. Commonly in tabular crystals. Massive; radiating fibrous; in stalactites. Brittle. Metallic luster. Color pale brass-yellow. Streak brownish-black. H. = 6 — 6½. G. = 4.85 — 4.90.

Roasted on charcoal, it gives sulphur odor and yields a magnetic residue. Distinguished from pyrite by crystal form.

Marcasite is rarer than pyrite, and is characteristic of the upper or altered parts of certain sulphide deposits.

Inyo County: Marcasite has been found with pyrite, pyrrhotite and chalcopyrite in the Curran mine, near Panamint, Sampson (32).

Napa County: Marcasite occurred abundantly with cinnabar at the old Redington mine, Knoxville. Marcasite has been found in the Palisades mine, about 2 miles north of Calistoga.

Nevada County: It is mentioned as one of the minerals of the Grass Valley mines by Lindgren (96).

LÖLLINGITE

Iron diarsenide, $FeAs_2$.

Orthorhombic. Small crystals. Usually massive. Metallic luster. Color silver-white to light steel-gray. Streak grayish-black. H. = 5 — 5½. G. = 7.0 — 7.4.

Similar to arsenopyrite in its reactions except that it gives no sulphur deposit in a closed tube.

Amador County: Small crystals of löllingite were found in the black slate at the Mayflower mine, Amador City.

ARSENOPYRITE

Sulpharsenide of iron, FeAsS.

Orthorhombic. Common in crystals. Generally compact to granular massive. Brittle. Metallic luster. Color silver-white to steel-gray. Streak grayish-black. H. = 5½ — 6. G. = 5.9 — 6.2.

Copious white volatile fumes of arsenic oxide and a strong garlic odor are obtained when arsenopyrite is roasted on charcoal. Residue becomes magnetic. Borax bead is yellow to pale-green. Decomposed by nitric acid with the separation of sulphur.

Arsenopyrite is a common vein mineral. The concentrates from most of the mining regions of the State generally contain arsenopyrite and in some districts it is the chief gold-bearing mineral.

Danaite is a variety containing from 3 to 9 per cent of cobalt.

Amador County: Arsenopyrite occurs with the gold ores in the Argonaut mine near Jackson, Josephson (32).

Calaveras County: Arsenopyrite, high in gold content, has been found near Angels Camp and in mines along the Mother Lode. Cobaltiferous arsenopyrite has been found on a claim known as the Hauselt Patent, 2 miles southeast of Sheepranch, Hess (27).

Del Norte County: It was found at Monkey Creek.

El Dorado County: It occurred at the Florence mine, near Placerville. Auriferous arsenopyrite occurs at the Frog Pond mine, half a mile north of Garden Valley; at the Barnes Eureka mine, near Shingle Springs; in the Mount Pleasant district.

Fresno County: Large amounts of arsenopyrite with pyrite and chalcopyrite occur in auriferous quartz in the NW$\frac{1}{4}$ Sec. 16, T. 13 S., R. 27 E., M. D. M.

Imperial County: It is found in the mines of the Cargo Muchacho district.

Inyo County: It was found in the Wilshire gold mine, 25 miles southwest of Laws, Turner (22).

Kern County: Good crystallized specimens of arsenopyrite occurred at the Long Tom mine; with quartz in the Amalie district; with galena and pyrite in quartz at the Bright Star mine, Piute district. Arsenopyrite occurs in the Big Blue-Sumner lode, half a mile north of Kernville, Tucker (34). It is common in the gold ores near Randsburg, Hulin (25).

Madera County: It occurs in small amounts on Iron Mountain.

Mariposa County: It occurs in the mines near Coulterville; danaite with erythrite was found in the Josephine mine, Bear Valley, Turner (96). Arsenopyrite with calcite and quartz in the Smith mine, Bear Valley; with magnetite in the Cave mining district; with chalcopyrite and pyrite at Hornitos. It was found at the Hite's Cove mine, R. W. Raymond (74).

Mono County: It is common in the Lundy district, carrying gold.

Monterey County: It occurs in auriferous quartz at the Oregon mine, Sec. 2, T. 24 S., R. 5 W., M. D. M.

Napa County: It occurs in the Palisades mine, 2 miles north of Calistoga.

Nevada County: A 2-foot ledge containing arsenopyrite was found at the Porcupine mine, Cisco. Fine crystals in schist were found on Poorman Creek; crystals on quartz at the Delhi mine, Columbia Hill.

Danaite was found in the Meadow Lake district, W. P. Blake (67). It was abundant in the veins of the Federal Loan mine, near Nevada City; crystals occur in the Osborne Hill vein. The veins of Forest Springs, 4 miles south of Grass Valley, also carry much arsenopyrite, Lindgren (96).

Placer County: Arsenopyrite is one of the minerals in the mines of the Ophir district, Lindgren (94). It occurs in the Canada Hill and Dutch Flat districts. Arsenopyrite containing nickel and cobalt has been found 3 miles from Cisco.

Plumas County: It occurred in the Pilot Hill gold mine, 6 miles northwest of Gibsonville, and has been found in Genesee Valley.

Riverside County: Small crystals occur in the limestone quarry at Crestmore, Eakle (17). Arsenopyrite occurs at the Cajalco tin mine, near Corona, West (28).

San Bernardino County: It occurs on San Antonio Peak. Small crystals of arsenopyrite occur abundantly in the silver ores of the Rand district, Hulin (25).

San Diego County: It occurs with the gold ores of the Julian district, Donnelly (34).

Santa Cruz County: Arsenopyrite occurs in the quarry of the Pacific Limestone Products Company at Santa Cruz.

Sierra County: Arsenopyrite is the chief gold-bearing mineral at Alleghany, containing a high percentage of gold. In the Golden King mine on Kanaka Creek it is said to have occurred with a gold telluride. It is common in the mines of the Forest Hill district, the Oriental, Osceola Lode, Uncle Sam, Rainbow, Bonanza, Mammoth Springs, Lost Treasure, Kate Hardy, and El Dorado mines; in the Eagle and Docile mines, Kanaka Creek; at the Mexican Elcy and High Commission mines, Downieville district; at Gold Canyon, 3 miles from Moores Flat; at the Kenton, Ironsides, and Four Hills mines with chalcopyrite and galena.

Tehama County: It occurs with quartz and pyrite at Sarkenita.

Trinity County: Gold-bearing arsenopyrite occurs in the Craig mine, 2 miles east of Dedrick; on Lowden's ranch and Burnt ranch with gold; near Weaverville.

Tulare County: It is found in the Mineral King district.

Tuolumne County: Crystals of arsenopyrite having crystallized gold deposited on them occur at the Alameda mine, Rawhide mining district.

MELONITE

Nickel telluride, $NiTe_2$.

Hexagonal. Commonly granular and foliated. Cleavage perfect basal. Metallic luster. Color reddish-white. Streak dark-gray. H. = 1 — 1½. G. = 7.3.

The tellurium is readily driven off in white oxide fumes when heated on charcoal. The roasted residue yields the brown bead of nickel with borax. Melonite also gives the characteristic violet solution of a telluride when boiled in strong sulphuric acid.

Calaveras County: Melonite was discovered among the other tellurides of the Melones mine on Carson Hill in 1867 and was named by Genth (67), (68). A similar mineral was later found in the Stanislaus mine and analyzed by Hillebrand (99).

	Te	NiCo	Pb	Ag
Genth	73.43	20.98	0.72	4.08 = 99.21%
Hillebrand	80.75	18.31	---	0.86 = 99.92%

SYLVANITE—Graphic Tellurium

Telluride of gold and silver, $(Au,Ag)Te_2$.

Monoclinic. Bladed crystals and massive. Cleavage perfect clinopinacoidal. Metallic luster. Color silver-white to yellow. Streak silver-gray. H. = 1½ — 2. G. = 7.9 — 8.3.

The tellurium is easily driven off as an oxide by heat, leaving a button of gold and silver. Gives a deep-violet solution when boiled with concentrated sulphuric acid. The silver can be extracted from the button by nitric acid and precipitated as silver chloride by hydrochloric acid.

Though sylvanite may be present in many of the gold districts where tellurium is found, it has been identified in but few localities in California.

Calaveras County: Sylvanite was one of the tellurides ocurring in the Carson Hill mines and was especially prominent in the Melones and Stanislaus mines. An analysis of sylvanite from the Stanislaus mine was made by Stetefeldt (65).

Te	Au	Ag
59.6	25.5	13.9

Trinity County: Sylvanite has been found with gold in the Yellow Jacket mine; with nagyagite at the Dorleska mine, Coffee Creek district, Stines (07); and in the Golden Jubilee mine, 5 miles northwest of Carrville, Averill (31).

Tuolumne County: It occurs in the Sugarman and Nigger mine, 2 miles north of Sonora.

Yuba County: It occurs with the gold in the Red Raven mine, Dobbins district.

CALAVERITE

Gold telluride, $AuTe_2$.

Monoclinic. Crystals with striated faces; also massive granular. Brittle. Metallic luster. Color pale bronze-yellow to yellowish silver-gray. Streak yellowish-gray. H. = 2½. G. = 9.04.

Similar to sylvanite in its reactions.

Calaveras County: Calaverite was discovered at the old Stanislaus mine on Carson Hill. Analyzed and named by Genth (68).

Au	Ag	Te
40.70	3.52	55.89 = 100.11%

It was also found in the Melones mine on Carson Hill.

El Dorado County: It was found with petzite in the Darling mine near Rock Creek, about 3 miles northeast of American Flat.

Siskiyou County: It was reported from the northern part of the county near the State line, associated with free gold and petzite.

NAGYAGITE

Sulpho-telluride of lead and gold.

Orthorhombic. Generally foliated and granular massive. Perfect cleavage into thin flexible laminae. Metallic luster. Color and streak dark lead-gray. H. = 1 — 1½. G. = 6.85 — 7.2.

Gives the yellow and white coatings of lead and tellurium oxides, when roasted on charcoal, with a slight odor of surphur. The presence of tellurium can best be tested by boiling in sulphuric acid and obtaining the violet color.

Trinity County: Nagyagite was observed with hessite at the Dorleska mine, Coffee Creek district.

OXYSULPHIDES

KERMESITE

Antimony oxysulphide, Sb_2S_2O.

Monoclinic. Usually in hair-like tufts. Cleavage (100) perfect. Metallic to adamantine luster. Color cherry-red. Streak brownish-red. H. = 1 — 1½. G. = 4.5 — 4.6.

Gives a reaction similar to stibnite.

Kern County: Fine red needles of kermesite were found on stibnite at the Mojave antimony mine, about 15 miles north of Mojave.

SULPHOSALTS

Miargyrite	Pyrargyrite	Geocronite
Berthierite	Proustite	Polybasite
Jamesonite	Stylotypite	Enargite
Dufrenoysite	Tetrahedrite	
Bournonite	Stephanite	

MIARGYRITE

Sulphantimonite of silver, $AgSbS_2$.

Monoclinic. In complex monoclinic crystals; also massive. Luster metallic-adamantine. Color iron-black to steel-gray, in thin splinters deep blood red. Streak cherry-red. H. = 2 — 2½. G. = 5.1 — 5.3.

San Bernardino County: Miargyrite is probably the most abundant silver mineral in the deposits of the Randsburg district. Well-formed crystals are found in open drusy cavities in the veins, Hulin (25). Shannon (29) has described crystals from the California Rand Silver mine showing the forms (001), (100), (011), (101), ($\bar{1}$01), (105), (111), (122), ($\bar{2}$11), (311), (522), (922), (411), (611), (711), (124) (413), and ($\bar{2}$13). Analysis by Shannon gave:

Ag	Cu	Fe	Pb	Sb	As	S	Insol.
36.20	0.02	0.56	0.95	42.46	tr.	19.27	0.80 = 100.26%

BERTHIERITE

Sulphantimonite of iron, $FeSb_2S_4$.

Long prismatic. Usually fibrous massive. Metallic luster. Color dark steel-gray. Streak grayish-black. H. = 2 — 3. G. = 4 — 4.3.

A slight coating of white oxide of antimony and a slight odor of sulphur can be obtained by roasting on charcoal. The roasted mineral becomes magnetic.

Tuolumne County: Heavy ledges of dark ore occur in an area of schists on the southeastern slope of Mount Gibbs, which appear to be an impure berthierite mixed with galena, pyrite, and quartz, Turner (96).

JAMESONITE

Sulphantimonite of lead, $Pb_2Sb_2S_5$.

Monoclinic. In acicular and capillary crystals. Generally fibrous massive. Cleavage perfect basal. Brittle. Metallic luster. Color lead-gray. Streak grayish-black. H. = 2 — 3. G. = 5.5 — 6.0.

The yellow and white coating on charcoal, of lead and antimony oxides, and odor of sulphur are obtained by heating. Dissolved in nitric acid, the lead goes into solution, while the antimony is precipitated as an oxide.

Calaveras County: Jamesonite was found at Mokelumne Hill, Hanks (84).

Inyo County: Compact massive specimens of jamesonite associated with argentiferous galena have come from the Cerro Gordo mine.

Napa County: Delicate capillary or hair-like crystals of jamesonite were found with cinnabar at the Manhattan mine, near Knoxville.

Sierra County: Crystal clusters and needles of jamesonite have been found in small vugs in quartz in the Rainbow and Plumbago mines, Alleghany district, Ferguson and Gannett (32).

DUFRENOYSITE

Sulpharsenite of lead, $Pb_2As_2S_5$.

Monoclinic. Generally massive. Cleavage (010) perfect. Brittle. Metallic luster. Color dark lead-gray. Streak reddish-brown. H. = 3. G. = 5.55 — 5.57.

Like jamesonite in its reactions, except that the more volatile fumes of arsenic trioxide, instead of the antimony, are given off.

Inyo County: Dufrenoysite was reported to have been found in the Cerro Gordo district, Hanks (84).

BOURNONITE

Sulphantimonite of lead and copper, $(Pb,Cu_2)_3Sb_2S_6$.

Orthorhombic. Short prismatic and tabular crystals; massive. Metallic luster. Color and streak lead-gray. H. = $2\frac{1}{2}$ — 3. G. = 5.7 — 5.9.

Fuses easily and on charcoal gives a white coating, at first of antimony oxide, followed by a yellow coating of lead oxide nearer the assay. Dissolved in nitric acid and ammonia added, the solution turns blue; soluble in hydrochloric acid with odor of hydrogen sulphide.

Inyo County: Massive bournonite occurs at Cerro Gordo, Reid (07).

PYRARGYRITE—Dark Ruby Silver Ore

Sulphantimonite of silver, Ag_3SbS_3.

Hexagonal-rhombohedral. Prismatic crystals; also massive. Cleavage $(10\bar{1}1)$ distinct. Brittle. Metallic luster. Color grayish-black, or dark-red. Streak purplish-red. H. = $2\frac{1}{2}$. G. = 5.85.

Gives a white antimony oxide coating on charcoal and reduces to a globule of metallic silver. The sulphur can best be detected by fusion in a closed tube.

Pyrargyrite is found in silver veins with argentite, polybasite, stephanite, tetrahedrite and other silver minerals. It is often embedded in quartz and good crystals of pyrargyrite may occur in cavities in quartz.

Alpine County: Pyrargyrite occurred in the old I X L and Exchequer mines of the Silver Mountain district. It was observed in the Monitor mining district, Eakle (19).

Kern County: It was found with argentite at the Amalie mine.

Mariposa County: It was found with argentite and proustite in the Bryant Silver mine.

Mono County: Pyrargyrite and stephanite were abundant in the Oro, Addenda, Fortuna and other mines south of Bodie. Crystals of pyrargyrite were found in a vug in the Bodie mine. It also occurred in the Blind Spring mines, in the Tower mine, and in other mines near Benton, Whiting (88).

Napa County: It is a constituent of the gold and silver ore in the Palisades mine, 2 miles north of Calistoga.

Nevada County: It was found with pyrite, chalcopyrite, and galena in the Allison Ranch mine; also in the Central mine of the Lava Cap Company, south of Banner Hill, and is probably present in other mines of the Grass Valley and Nevada City district as indicated by the silver-rich concentrates, Lindgren (96).

San Bernardino County: Pyrargyrite occurs with miargyrite in the silver ores of the Rand district, Hulin (25).

Shasta County: Small amounts of pyrargyrite were occasionally found in the mines near Igo.

PROUSTITE—Ruby Silver Ore

Sulpharsenite of silver, Ag_3AsS_3.

Hexagonal-rhombohedral. Prismatic crystals and massive. Cleavage $(10\bar{1}1)$ distinct. Brittle. Adamantine luster. Color and streak scarlet-red. H. = 2 — 2½. G. = 5.57 — 5.64.

The reactions of proustite are similar to those of pyrargyrite. The two minerals often are intermixed or grade into each other.

The term 'ruby silver' is given indiscriminately to proustite and pyrargyrite. Both minerals usually contain arsenic and antimony. The metallic gray pyrargyrite is more common than the transparent red proustite, but the two are often associated.

Kern County: Specimens of proustite with pyrargyrite have come from the old Amalie district.

Mariposa County: It occurred with pyrargyrite and argentite in the Bryant Silver mine.

Mono County: It was found in the Oro and Bodie mines, Bodie district, Hanks (84).

Napa County: Proustite has been found in the Palisades mine, about 2 miles north of Calistoga.

San Bernardino County: Proustite is a minor constituent of the silver ores of the Rand district, Hulin (25).

Shasta County: It occurred with galena, pyrite and quartz in the Chicago mine, near Igo.

STYLOTYPITE

Sulphantimonite of copper and silver, $3(Cu_2,Ag_2,Fe)S.Sb_2S_3$.

Monoclinic. Granular or massive. Brittle. Metallic luster. Color dark-gray to iron-black. Streak black. H. = 3 — 3½. G. = 4.7 — 5.2.

San Bernardino County: Stylotypite occurs with miargyrite as an important constituent of the silver ores of the Rand district, Hulin (25).

TETRAHEDRITE—Gray Copper Ore

Sulphantimonite of copper, Cu_3SbS_3.

Isometric; hextetrahedral. Also massive; granular. Metallic luster. Color dark steel-gray. Streak black, sometimes cherry-red. H. = 3 — 4. G. = 4.4 — 5.1.

Gives a slight white coating on charcoal and a faint odor of sulphur. The roasted mineral gives the blue bead of copper with borax. Soluble in nitric acid and the antimony precipitates as trioxide. Ammonia added to nitric acid solution will give the characteristic blue solution of copper, and will precipitate any iron present.

Tetrahedrite is common in many of the gold and copper mines of the State. It is, however, seldom prominent but occurs in small amounts mixed with galena, sphalerite, chalcopyrite and other common sulphides.

Freibergite is the argentiferous variety and is perhaps the most common form of the mineral in California.

Alpine County: Considerable tetrahedrite has been found in the Silver Mountain district. It was observed in the Monitor mining district, Eakle (19).

Calaveras County: Small amounts of tetrahedrite were found in the mines on Carson Hill. It was present in the ore at the Jones mine, Carson Creek.

Del Norte County: It was found at Crookeshine.

Imperial County: It occurred in the Blue Jacket and other mines of the Picacho district.

Inyo County: Tetrahedrite containing a large percentage of silver was an important mineral in the Cerro Gordo district. It also occurred in some of the mines of the White Mountains and the Dutton Range. It was found in the old San Carlos mine. Freibergite is the principal sulphide in the silver ores of the Panamint district, Murphy (30a). *Tennantite,* the arsenic-bearing equivalent of tetrahedrite, has been reported from the Darwin district by Kelley (37).

Los Angeles County: It was found in the Zapate mine in San Gabriel Canyon.

Mariposa County: Freibergite was found in large masses in white quartz, at the Live Oak mine, near Mariposa, Hanks (84). It also occurred in the Pine Tree mine, near Coulterville and in the Louisa and Bunker Hill mines.

Mendocino County: It was found with chalcopyrite, gold, and silver in the Redwood Copper Queen mine.

Mono County: It occurred massive associated with partzite in the Diana, Comet, Comanche, and other mines of the Blind Spring Hill district; also found in the Bodie district.

Nevada County: A heavy mass of tetrahedrite associated with zincblende and chalcopyrite was found in the Osborn Hill vein. Tetrahedrite was found in small quantities at the North Banner and at other mines of the Banner Hill and Willow Valley districts, Lindgren (96). It is present in the ore in the Badger Hill mining district. Argentiferous tetrahedrite is abundant in the Central mine of the Lava Cap Gold Mining Corporation at Nevada City, Johnston (38).

Placer County: Dark steel-gray tetrahedrite associated with other sulphide minerals and with electrum was common in the Ophir district, having been noticed in the Boulder, Gold Blossom, Pine Tree and Golden Stag mines, Lindgren (94). It was also observed at Michigan Bluff.

Plumas County: It was found at the Irby Holt mine in Indian Valley. Argentiferous tetrahedrite was found at the Trask and Coffer mine. It was observed in small amounts in the ore at Engels.

Riverside County: A small amount of tetrahedrite was found with chalcopyrite, pyrite, and galena, at Crestmore, Eakle (17).

San Bernardino County: It has been found massive in the New York and other mines in the New York Mountains.

Shasta County: Tetrahedrite is of rather common occurrence in the copper mines of the county although in small amounts. It has been found in a barite gangue in the Bully Hill mine.

Sierra County: Tetrahedrite occurs in tetrahedral crystals with crystallized gold in the 16 to 1 mine at Alleghany.

Tuolumne County: It occurred as one of the minerals on Whiskey Hill, Silliman (67a). Massive tetrahedrite was found in the Golden Rule mine, near Jamestown.

STEPHANITE—Brittle Silver Ore

Sulphantimonite of silver, Ag_5SbS_4.

Orthorhombic. Crystals common, showing at times striations on the prism faces; also massive. Brittle. Metallic luster. Color and streak iron black. H. = 2 — 2½. G. = 6.2 — 6.3.

The reactions are similar to those for pyrargyrite, but the streak or powder is black, whereas that of pyrargyrite is reddish.

Stephanite is an important and usually prominent silver mineral in silver districts, but it is not common in California. It is often associated with argentite and polybasite as an original mineral of the veins.

Alpine County: Stephanite was reported to have been found in the Morning Star mine, J. D. Dana (49).

Mono County: Stephanite occurred in the Blind Spring Hill district. Large masses of it were found with pyrargyrite in the Oro, Addenda, and Fortuna mines, Bodie district, Whiting (88). It is found in the Patterson district, Sweetwater Range.

Nevada County: Stephanite was one of the minerals found in the Grass Valley mines, Lindgren (96).

Shasta County: It occurs with native silver, galena, and sphalerite in a calcite-quartz gangue at the Igo Consolidated Mines.

GEOCRONITE

Sulphantimonite of lead, $Pb_5Sb_2S_8$.

Orthorhombic. Generally massive, granular, or earthy. Metallic luster. Color and streak lead-gray. H. = 2 — 3. G. = 6.4.

Gives the same reactions as jamesonite.

Inyo County: According to Hanks (84), small masses of geocronite were found with galena in the Inyo Mountains.

Mono County: It was observed with galena and sphalerite in the Garibaldi mine, Prescott district.

POLYBASITE

Sulphantimonite of silver, Ag_9SbS_6.

Monoclinic. Tabular crystals and massive. Metallic luster. Color iron black. Streak black. H. = 2 — 3. G. = 6.0 — 6.2.

In its blowpipe reactions polybasite is like stephanite and pyrargyrite.

Polybasite closely resembles stephanite; the two are often mixed and are seldom differentiated. When in good crystals they can be distinguished, but when massive their separate identification is difficult.

Alpine County: Specimens of polybasite have come from the Pennsylvania mine in the Silver Mountain district, and Hanks (84) observed it in microscopical crystals from the Monitor and Mogul districts.

ENARGITE

Sulpharsenate of copper, Cu_3AsS_4.

Orthorhombic. Crystals and massive. Cleavage perfect prismatic. Brittle. Metallic luster. Color and streak grayish-black. H. = 3. G. = 4.4.

Fuses and gives a faint coating on charcoal. The roasted mineral can be reduced to metallic copper by fusion with sodium carbonate. The borax bead is blue. Soluble in nitric acid with the precipitation of a small amount of antimony trioxide.

Alpine County: Enargite was found in large masses associated with massive pyrite in the Mogul district and formed the chief copper mineral of the Morning Star and a few other mines. An analysis of enargite from the Morning Star mine by Root (68) gave:

S	Cu	As	Sb	
31.68	47.21	14.06	6.19 = 99.14%	G. = 4.34.

Crystals have the forms: (110), (001), (100), (010), Silliman (73b), and (130), (250), (101), Eakle (08).

El Dorado County: Enargite was found in the Ford mines, near Georgetown.

Inyo County: The variety *luzonite* is found in the silver-lead ores of the Darwin district, Kelley (37).

Plumas County: Small amounts of enargite occur with bornite and chalcopyrite at Engels.

HALOIDS

Anhydrous Chlorides, Bromides and Fluorides	Sal Ammoniac	*Oxychlorides*
Calomel	Cerargyrite	Atacamite
Halite	Embolite	Kempite
	Fluorite	Eglestonite
	Chloromagnesite	

ANHYDROUS CHLORIDES, BROMIDES AND FLUORIDES

CALOMEL

Mercurous chloride, HgCl.

Tetragonal. Small crystals. Sectile. Adamantine luster. Color white, gray, brown. Streak pale yellowish-white. H. = 1 — 2. G. = 6.48.

Volatilizes easily on charcoal and coats the coal white. Calomel is easily reduced to mercury globules by fusion with soda.

Napa County: White coatings of calomel on metacinnabar occurred at the Oat Hill mine.

San Mateo County: Small amounts of calomel with cinnabar, native mercury, and eglestonite occur about 5 miles west of Palo Alto, Rogers (11a).

HALITE—Common or Rock Salt

Sodium chloride, NaCl.

Isometric. Cubes, massive, granular, and crusts. Cleavage perfect cubic. Rather brittle. Vitreous luster. Colorless, white, yellowish, reddish, bluish. H. = 2½. G. = 2.1 — 2.6.

Fuses with intumescence and gives a strong yellow flame. Easily soluble in water and has a saline taste.

Most of the salt produced in the State is obtained by the evaporation of the water of San Francisco Bay; also at San Diego and Monterey Bays; yet extensive deposits of the mineral exist in the southern counties and some of them are mined. Salt is common in the desert regions, where former lakes existed, and the deposits reach considerable thickness in some localities, often alternating with beds of sulphates, borates, carbonates, and mud shales. Salt wells, salt springs, salt marshes, and salt rivers occur in these arid plains, and white incrustations of salt are often found along their borders.

Alameda County: The salt works near Alvarado evaporate the water of San Francisco Bay on a large scale.

Imperial County: Efflorescences of salt occur on the dry plains of the Great Colorado Desert.

Inyo County: Halite is common in the dry valleys as white efflorescences. It is common in the borax district of Death Valley, Gale

(14). White crusts of salt in Saline Valley have been analyzed by Bailey, Gale (14a), and shown to be largely halite.

Na	K	Cl	SO_4	H_2O	Insol.
39.09	0.11	59.76	0.95	0.12	0.17 = 100.20 %

Kern County: Numerous salt lakes and wells occur in the Mojave Desert region on the east side of the county. Salt and borax are associated at Buckthorn, Indian, and Mesquite springs.

Lake County: Halite is found in minute crystals with borax and gay-lussite at Borax Lake, Melhase (35).

Modoc County: Salt is produced in commercial quantities near Cedarville, in Surprise Valley.

Riverside County: The Salton Sea is an extensive depression in the south-central part of the county which was noted for its immense deposits of white salt, of which thousands of tons have been mined. An analysis of this salt was made by E. T. Allen, Clarke (03).

NaCl	KCl	Na_2SO_4	Gypsum	H_2O	Insol.
94.54	0.31	3.53	0.79	0.14	0.50 = 99.81 %

San Bernardino County: Numerous dry lakes exist in this county, all of which contain salt. Some of the salt near Daggett has been mined for chloridizing the silver ores of the district. A large lake deposit of salt occurs in the desert about 25 miles southeast of Danby and the Surprise salt mines have produced large quantities. Bailey (02) reports a vein of rock salt 12 to 16 feet thick on the Avawatz Mountains. Crusts of halite with sodium, magnesium, and calcium sulphate occur at the Mojave sink. Salt and borax with nitrates occur along the Amargosa River, near the Inyo County line. Cubic and octahedral crystals of halite, with hanksite, trona, and glaserite, occur in the salt crust of Searles Lake. Clear cubical crystals and cleavable masses of halite occur with gypsum on the muds of Bristol Lake, near Amboy.

San Luis Obispo County: White crusts of salt can be found in many places along the shores of the Salinas River. Soda Lake in Carrizo Plain is a dry lake in the eastern part of the county, the surface of which contains crusts of salt and sodium sulphate.

Shasta County: Sandstones which are slightly impregnated with salt occur on Salt Creek, about 12 miles east of Redding.

SAL AMMONIAC

Ammonium chloride, NH_4Cl.

Isometric. Crystals, crusts, and efflorescences. Rather brittle. Vitreous. White, yellowish, grayish. H. = $1\frac{1}{2}$ — 2. G. = 1.528.

Very easily volatile without fusion when heated and is wholly converted into dense white fumes. Heated in a closed tube with soda or lime, ammonia is given off which can be detected by odor. Soluble in water.

Inyo County: According to Bailey (02), sal ammoniac is found as efflorescences at some of the fissure springs in Death Valley.

Los Angeles County: A white crystalline incrustation of sal ammoniac was found in the Monterey shale of Burning Mountain, Rogers (12).

Santa Barbara County: Crusts of sal ammoniac 5 mm. thick, associated with sulphur, came from burning oil-shales on the Hope ranch, Rogers (12).

CERARGYRITE—Horn Silver

Silver chloride, AgCl.

Isometric. Usually in crusts, resembling wax or horn; sometimes columnar. Highly sectile. Luster resinous to adamantine. Color gray, but generally tarnished brown. H. $= 1 - 1\frac{1}{2}$. G. $= 5.55$.

Easily reduced on charcoal to metallic silver. Mixed with copper oxide it imparts to the flame the azure-blue color of the copper chloride flame. Insoluble in acids, but soluble in ammonia.

Cerargyrite has been among the important silver ores of the State. It is characteristic of silver deposits located in arid regions and may be abundant in such regions. It is usually accompanied by embolite and occasionally by iodyrite; barite is a common gangue mineral.

Calaveras County: W. P. Blake (67) reported the occurrence of thin crusts of cerargyrite on quartz in the Morgan mine at Carson Hill.

Inyo County: Horn silver with argentiferous galena, argentite, and copper minerals has been found abundantly in the Argus and Coso Ranges and to some extent in the Darwin and Cerro Gordo districts. Hanks (84) mentions it from the Slate Range, and as microscopical crystals from the Modoc mine near Darwin. Cerargyrite with cerusite occurs in the Noonday mine, Tecopa, and associated with chrysocolla at the Bonanza King mine, Sherman district.

Kern County: Cerargyrite has been found in the Amalie mine with pyrargyrite and native silver. It occurs at the Golden Queen mine, 7 miles south of Mojave, Tucker (34).

Mono County: Cerargyrite has been found in the Blind Spring Hill district near Benton and in some of the mines of the Bodie district, but never in large masses. It occurs in the Sweetwater Range.

Placer County: Cerargyrite is abundant in the gold-silver veins of the Ophir district, Lindgren (94).

San Bernardino County: Horn silver has been a very important silver mineral in the Calico and Barstow mines, Lindgren (87), Storms (90). The minerals associated with the horn silver of this region are embolite, cerusite, barite, pyrolusite, chrysocolla, malachite, and jasper. Cerargyrite occurs in limestone with embolite, wulfenite, sphalerite, galena, cerusite, and pyrite in the Silver Reef district, about 40 miles east of Victorville; and with argentite at the Bonanza King mine on

Providence Mountain and in the Imperial mine, Lava Beds district, about 9 miles from Lavic. Cerargyrite is the principal secondary ore mineral in the silver mines of the Rand district, Hulin (25).

EMBOLITE

Silver chloro-bromide, Ag(Br,Cl).

Isometric. Generally massive. Sectile. Resinous luster. Color grayish-green, yellow. H. = 1 — 1½. G. = 5.31 — 5.43.

Heated in a closed tube with potassium bisulphate and pyrolusite, red vapors of bromine are set free. Heated in closed tube with galena, yellow lead bromide forms, which turns white on cooling. Silver nitrate will precipitate silver bromide from a nitric acid solution.

Embolite has only been found in association with cerargyrite but in much smaller amounts.

Inyo County: Embolite is found with cerargyrite in the Indiana mine, near Swansea, Hanks (84).

Mono County: Embolite occurs with cerargyrite in the Minnie mine, Sweetwater Range, Hanks (84).

San Bernardino County: Embolite is an associate of the cerargyrite in the Calico, Grapevine, and Silver Reef districts.

FLUORITE

Calcium fluoride, CaF_2.

Isometric. Usually in cubes; also massive, granular, or compact. Cleavage perfect octahedral. Brittle. Vitreous luster. Green, purple, blue, white, yellow, colorless. Streak white. H. = 4. G. = 3.01 — 3.25.

Fuses with some decrepitation. Gives reddish flame of calcium. Soluble in acids and calcium is precipitated by ammonium oxalate. Mixed with potassium sulphate and fused in a closed tube, the glass becomes etched.

Fluorite is a common mineral, especially as gangue in lead districts with galena. It sometimes forms thick veins.

Contra Costa County: Small cubes of white fluorite were found on Mount Diablo with some copper minerals, Hanks (84).

Inyo County: Fluorite is found as a gangue mineral with argentiferous galena in the Cerro Gordo, Darwin and other districts.

Kern County: Fluorite veins occur in the west end of the Rand Mountains near Randsburg.

Los Angeles County: Fine specimens of fluorite consisting of purple and green masses and cubes have come from the Felix mine near Azusa. White fluorite occurred on Santa Catalina Island with galena and chalcopyrite.

Mono County: Green and violet crystals and masses of fluorite occur in Ferris Canyon on the eastern slope of the Sweetwater Mountains. Fluorite occurs with andalusite in the mine of Champion Silli-

manite, Incorporated, on the western slope of the White Mountains, 7 miles east of Mocalno, Woodhouse and Jeffery (32).

Riverside County: Transparent crystals of fluorite were marketed for optical purposes in 1917-1918, from the Floyd Brown mine, near Blythe. A small tonnage was also shipped for industrial use.

San Bernardino County: Green and purple fluorite with some iceland spar comes from the Kings Fluorspar mine, Cave Canyon district, Tucker and Sampson (31). Light-green fluorite occurs near Barstow. Fluorite is also found near Ludlow and near Needles.

San Diego County: Green fluorite occurs at Oak Grove, Palomar Mountains. A small amount of fluorite is found at the Mountain Lily Gem mine, Aguanga Mountain.

Tulare County: A deposit of massive fluorite occurs in Sec. 34, T. 20 S., R. 31 E., M. D. M., 18 miles east of Springville, Franke (30a).

CHLOROMAGNESITE

Magnesium chloride, $MgCl_2$.

Efflorescence. Color white. Soft.
Soluble in water. Easily fusible.

Magnesium chloride exists in solution in the waters of some springs and lakes, but its solubility prevents it from forming as a mineral except in the driest places.

San Bernardino County: White efflorescences of chloromagnesite occur at Saratoga Springs, near the south end of Death Valley, Bailey (02).

OXYCHLORIDES

ATACAMITE

Hydrous copper oxychloride, $Cu_2Cl(OH)_3$.

Orthorhombic. Slender needles and fibrous reticulated masses. Cleavage (010) highly perfect. Brittle. Luster adamantine to vitreous. Color bright to black-green. Streak apple-green. H. = 3 — 3½. G. = 3.7.

Fuses and imparts an azure-blue color to the flame. Readily reduced on charcoal to metallic copper. Gives much acid water in a closed tube, and forms a gray sublimate. Easily soluble in acids.

Atacamite is very rare and its occurrence in California has not been definitely established.

Inyo County: J. D. Dana (68) recorded atacamite from an unknown locality in this county. As the Cerro Gordo mine was the best known for rare minerals, the atacamite, if correctly identified, perhaps came from this mine.

KEMPITE

Hydrous manganese oxychloride, $MnCl_2.3MnO_2.3H_2O$.

Orthorhombic. Minute prismatic crystals. Color emerald-green. H. = 3½. G. = 2.94.

Soluble in dilute acids. Gives water in the closed tube.

Santa Clara County: Kempite was found with pyrochroite, hausmannite, and rhodochrosite in a boulder of manganese ore in Alum Rock Park, 5 miles east of San Jose. It was discovered and named, and the crystal forms (110), (011), (121), (100), and (010) identified by Rogers (24). Analysis by Crook.

Mn	Cl	H_2O	O*
50.59	16.41	11.60	21.40 = 100%

* By difference.

EGLESTONITE

Mercury oxychloride, Hg_4Cl_2O.

Isometric. Minute crystals. Resinous to adamantine luster. Color yellowish-brown, changing to black. H = 2 — 3. G. = 8.327.

Volatilizes completely and does not give water in the closed tube.

San Mateo County: Minute yellow crystals of eglestonite associated with cinnabar, mercury, calomel, dolomite, magnesite, opal, and quartz occur about 5 miles west of Palo Alto in seams and cavities in the siliceous material so common in the serpentine of the cinnabar districts. The crystals were described and analyzed by Rogers (11a). Forms: cube (100), octahedron (111), dodecahedron (110), and trapezohedron (211).

Hg	Cl
88.00	7.43

OXIDES

Anhydrous
- Quartz
- Chalcedony
- Tridymite
- Cristobalite
- Opal

- Arsenolite
- Claudetite
- Valentinite
- Bismite
- Ilsemannite
- Cervantite
- Stibiconite
- Partzite

- Cuprite
- Periclase
- Massicot
- Litharge
- Tenorite
- Montroydite

Hematite Group
- Corundum
- Hematite
- Ilmenite

Spinel Group
- Spinel
- Magnetite
- Chromite

- Chrysoberyl
- Hausmannite
- Minium
- Crednerite
- Braunite

- Cassiterite
- Rutile
- Anatase
- Brookite

Hydrous
- Pyrolusite

Diaspore Group
- Diaspore
- Goethite
- Manganite

- Limonite
- Bauxite
- Brucite
- Pyrochroite
- Psilomelane

ANHYDROUS OXIDES

QUARTZ

Silicon dioxide. SiO_2.

Hexagonal-rhombohedral; trigonal-trapezohedral. Hexagonal prisms with pyramids very common and sometimes large. Compact and granular massive. Prominent conchoidal fracture. Brittle. Vitreous luster. Colorless, white, yellow, red, brown, green, blue, black. Streak white. H. = 7. G. = 2.65.

Infusible and insoluble in nitric or hydrochloric acids. Soluble in hydrofluoric acid. Fused well with a flux of sodium carbonate, the fusion dissolved in water and hydrochloric acid, when evaporated to dryness, will leave the silica as an insoluble residue. The hydrochloric acid solution, after all silica is removed, will give no precipitates of aluminum, calcium or magnesium when treated successively with ammonium, ammonium oxalate and sodium phosphate, proving the mineral to be silica and not a silicate.

Common quartz is an essential constituent of granites, granodiorites, quartz-porphyries, rhyolites, gneisses, schists, quartzites and sandstones, and is an accessory mineral in many other kinds of rock, either volcanic, metamorphic, or sedimentary. Veins, ledges, seams, and pockety masses of white quartz are common in volcanic and metamorphic rocks.

Rock crystal is a clear colorless variety which is found as hexagonal crystals.

Amethyst is a violet-colored variety sometimes used as a gem. It occurs in groups of crystals; rarely massive. Very little good amethyst has been found in the State.

Rose quartz is a massive pink variety.

Smoky quartz or *Cairngorm stone* is a hair-brown transparent variety occurring as crystals. The color is readily discharged or converted into citrine-yellow by heat. This is a common variety of quartz and some excellent large crystals have been found in the State.

Inclusions of other minerals in quartz are common and have several varietal names.

Thetis hairstone is rock crystal containing long hair-like fibers of asbestos or actinolite.

Phantom crystals show the outlines of one crystal within another; they are caused by inclusions of green chloritic matter or brownish earthy material arranged about the boundaries of the crystal during growth.

Alameda County: Yellow crystals of quartz occur with glassy albite at the Newman mine on Cedar Mountain, 12 miles southeast of Livermore.

Alpine County: Rose quartz has been found in Hope Valley and in the Mogul and Monitor districts.

Amador County: Fine large specimens of rock crystal have come from Volcano and Oleta. This section has also produced good specimens of amethyst, smoky, and rose quartz. Thetis hairstone has been found at Oleta.

Butte County: Smoky quartz occurs on the North Fork of the Feather River. Fine rose quartz occurs near Forbestown.

Calaveras County: Good rock crystal in fine large aggregates has been found in many of the gold mines. Mokelumne Hill, Green Mountain gravel mine near Murphy, Angels Camp, and Westpoint have produced large crystals. Clear quartz crystals occur at the Jennie Lind mine.

El Dorado County: The best rock crystal, phantom crystals, and smoky quartz in the State have come from near Placerville. A fairly pure white quartz is found on the McDonald ranch near Shingle Springs. Clear crystals are found in White Rock Canyon near Georgetown. Quartz with actinolite occurs near Fairplay. A blue variety of quartz occurring in pegmatite in this county has been named *El Doradoite* by Watkins (17).

Inyo County: Good rock crystal has been found in the Cerro Gordo and Darwin districts.

Kern County: Rose quartz has been reported north of Kernville.

Lake County: Quartz inclusions in basalt near Clear Lake Highlands, Anderson (36), have been called 'Clear Lake diamonds.' Amethystine quartz has been mined for gems in Secs. 10, 20, and 21, T. 12 N., R. 7 W., M. D. M., Averill (29).

Los Angeles County: Thetis hairstone has been found near Los Angeles. Vein quartz 30 feet thick has been reported 6 miles northwest of Acton. Pseudomorphs of quartz after fluorite have been found in sandstone and breccia near Encino and near the head of Higgins Canyon on the northern slope of the Santa Monica Mountains, Murdoch (36).

Marin County: Quartz amygdules occur on Mount Tamalpais.

Mariposa County: Fine rock crystal occurs at Mount Bullion. Rogers (35) has described the ocurrence of a large mass of quartz showing prominent parting, at White Rock on the Helm ranch, about 25 miles east of Merced.

Mono County: Rock crystal, amethyst, and tabular drusy quartz have come from the Bodie district.

Monterey County: White quartz sand occurs in dunes at Del Monte and Carmel Bay.

Napa County: Good rock crystal occurs near Calistoga.

Nevada County: Good specimens of rock crystal have come from Grass Valley and Nevada City. Large crystals occur near Washington.

Placer County: Rock crystal occurs in the Ophir district. Quartz and rock crystals, some with inclusions of green chlorite, occur at Shady Run.

Plumas County: Rock crystal has come from the Granite Basin. Deep-colored rose quartz has come from Meadow Valley.

Riverside County: Rock crystal, smoky quartz, and pink quartz are associated with the gem tourmaline at Coahuila. Granular quartz occurs in the Crestmore limestone quarry, Eakle (17). Massive quartzite occurs in large quantity on the Eagle Mountains. White quartz is obtained from a pegmatite at the Southern Pacific Silica quarry near Nuevo.

Sacramento County: Rock crystal of fine quality is found at Folsom.

San Benito County: Amethyst crystals of fair color were found in vugs in the San Carlos mine of the New Idria Quicksilver Company.

San Bernardino County: Quartz with rutile needles has been found in the San Bernardino Range. It is found as pseudomorphs after calcite at Hart. Clear white quartz occurs in the Fremont min-

ing district. It occurs with specular hematite and epidote in the San Bernardino Mountains about 30 miles northeast of San Bernardino.

San Diego County: Rock crystals, smoky quartz, and pink quartz are associated with the green and pink tourmaline of the county. Large groups of crystals of a deep-rose color occur in the pegmatite veins which carry the tourmaline at Pala, Mesa Grande, and Rincon. Rock crystal with long and almost black needles of tourmaline occurs at Pala. Crystals from Pala and Rincon have the forms: $(30\bar{3}1)$, $(40\bar{4}1)$, $(50\bar{5}1)$, $(11\bar{2}1)$, $(31\bar{4}1)$, $(41\bar{5}1)$, and $(51\bar{6}1)$, G. A. Waring (05). Smoky and ordinary quartz from Rincon have been spectroscopically examined by Kennard (35). An opalescent rose quartz occurs at Escondido. Tourmalinated quartz has been found on the east side of Chihuahua Valley.

Santa Clara County: Rogers (31a) has described paramorphs of quartz after tridymite in rhyolite at Lone Hill, near Los Gatos.

Stanislaus County: A large ledge of quartz occurs about 12 miles above Patterson on El Puerto Creek. Analysis:

SiO_2	Al_2O_3	Fe_2O_3
99.78	0.21	none

Tulare County: Rock crystal occurs at Three Rivers and in Drum Valley. Rose quartz is found at Bull Run Meadows and at Yokohl. Quartz with inclusions of hornblende is found at Deer Creek. Beautiful rose quartz occurs at the Summer Rose Quartz claim, 8 miles southeast of California Hot Springs near the Kern County line. Rose quartz occurs on the west side of Bull Run Ridge; near Badger; in pegmatite on ridge west of Dry Creek, about 5 miles north of Lemon Cove. Rose quartz occurs in a pegmatite with massive black allanite on the Gasenberger ranch near Exeter.

CHALCEDONY

Silicon dioxide, SiO_2.

Cryptocrystalline. Waxy luster. Translucent to opaque. White, gray, blue, brown, black. H. = 7. G. = 2.6.

Reactions the same as for quartz.

Chalcedony occurs in dense masses and layers, often banded. Many large masses of chalcedony and jasper have been deposited by springs. Chalcedony is a common secondary filling of cavities and fissures in volcanic rock, and may form large geodes in this way. Many names are given to the varieties of cryptocrystalline quartz that may be classed under chalcedony, most of them based on color and structure. They include *chalcedony, agate, carnelian, sard, prase, heliotrope* or *bloodstone, chrysoprase, onyx, sardonyx, jasper,* and *flint,* all of which are found in the State. Ordinary petrified wood is largely agate or chalcedony.

Myrickite is a local name applied to chalcedony having blood-red spots and patches of cinnabar.

Kinradite is a local name given to a spherulitic jasper.

Alameda County: Small geodes of chalcedony are common in the Berkeley Hills.

Alpine County: Red jasper is common in the Monitor district.

Amador County: Bluish chalcedony occurs at Volcano.

Calaveras County: Red, green, and brown jasper is found near Murphy. Petrified wood occurs at Angels Camp.

Del Norte County: Agate, chalcedony, and jasper pebbles are common beach pebbles at Crescent City.

Fresno County: Banded, delicately-veined masses of white chalcedony occur at Panoche. Jasper occurs in Stone Canyon and Jasper Canyon near Coalinga, Melhase (34).

Humboldt County: The beach pebbles at Big Lagoon are agate, chalcedony, jasper, prase, and carnelian. Red jasper is common at Shelter Cove.

Imperial County: Fine agates are found as drift pebbles in the Colorado Desert near Canyon Springs.

Inyo County: Porcelain jasper has been found in the Coso district. Blue agate and myrickite are found near Meerschaum Springs in the Death Valley region, Melhase (34).

Kern County: Deep-blue and sky-blue masses of chalcedony occur near Cane Springs. Petrified wood and agate occur at Red Rock Canyon, Melhase (34).

Los Angeles County: The beach pebbles at Redondo are largely chalcedony. Jasper and onyx form a mottled stone found on Santa Catalina Island, Randolph (35); locally known as *'Catalinite.'* Agates and geodes occur abundantly near Vasquez Rocks in Mint Canyon, Patton (36).

Marin County: The beach pebbles at Bolinas are in part agate and chalcedony. Red jasper outcrops on the Reed ranch. Kinradite occurs on the shore west of Sausalito between Point Bonita and Lime Point.

Napa County: Red jasper is found on Mount St. Helena. Chalcedony is common at the Manhattan cinnabar mine, Knoxville. Fine, banded onyx is also obtained there.

Nevada County: Brown jasper occurs at Nevada City. Good moss agate is found near Indian Flat.

Placer County: Fine geodal masses of chalcedony have been found at the Spanish mine, Ophir district. The beach pebbles at Lake Tahoe contain chalcedony, agate, jasper, carnelian, and prase.

Plumas County: Banded green and red jasper occurs in the slates and schists west of Meadow Valley.

San Benito County: Bluish-gray chalcedony occurred as pseudomorphs after elongated crystals of barite and also formed shells about oily bituminous matter, in the Phipps Quicksilver mine, east of Emmett.

San Bernardino County: Moss agate has come from the San Bernardino Mountains. Bluish chalcedony is associated with opal in the Black Mountains north of Barstow. Myrickite occurred in bunches and small masses 15 miles northeast of Lead Pipe Springs. Fine blue chalcedony occurs 2 miles northeast of Lead Pipe Springs. Bloodstone occurs in vesicular basalt with jasper near Lead Pipe Springs.

San Diego County: Red and white banded chalcedony occurs southeast of Dalzura and east of the Donohue mine. The amethystine-colored chalcedony found east of San Diego has been called '*violite.*'

San Francisco County: Red, green, and brown jasper is common in the serpentine of San Francisco. Kinradite is found near Land's End.

San Mateo County: The beach pebbles at Pescadero contain chalcedony, agate, carnelian, and jasper.

Santa Barbara County: The beach pebbles of this county contain agate and chalcedony.

Santa Clara County: Fine orbicular jasper is found near Morgan Hill, Melhase (34).

Siskiyou County: Jasper is common with the numerous serpentine masses of the county.

Sonoma County: Red jasper is found at Windsor. The petrified wood of the Petrified Forest west of Calistoga is largely chalcedony.

Trinity County: Jasper occurs on Red Mountain at the head of Prospect Peak.

Tulare County: Fine moss agate occurs on Deer Creek. Chrysoprase is found at Yokohl. Chrysoprase was mined on the eastern slope of the Venice Hills; at Stokes Mountain; on the Tule River; on Deer Creek; and 1 mile east of Lindsay.

Tuolumne County: Yellow and brown jasper occurs at Shaws Flat.

7—51440

TRIDYMITE

Silicon dioxide, SiO_2.

Orthorhombic. Thin pseudo-hexagonal plates, often overlapping. Brittle. Vitreous luster. Colorless to white. H. = 7. G. = 2.28 — 2.33.

Reactions the same as for quartz.

Tridymite is a form of silica which is found in recent volcanic rocks. It is generally of microscopic size and therefore is rarely seen, except in thin sections of rocks. As a rock mineral it may occur in all of the recent volcanics.

Imperial County: Tridymite with cristobalite and feldspar is a principal constituent of an altered rhyolite obsidian which makes up Cormorant Island in the Salton Sea, Rogers (26).

Inyo County: Tridymite occurs in lithophysae in obsidian at Little Lake, 40 miles south of Owens Lake, Wright (16).

Lake County: Druses and groups of sharp tridymite crystals occur in vugs and seams in andesite in Seigler Canyon, near Lower Lake.

Mono County: Schaller, (05a) has described small plates of tridymite with the forms: (0001), $(10\bar{1}0)$, $(32\bar{5}0)$, $(54\bar{9}0)$, $(30\bar{3}4)$, and $(10\bar{1}2)$, in the cavities of lava near Bridgeport.

San Luis Obispo County: Tridymite is found in lithophysae in rhyolite on Black Mountain in the southern Santa Lucia Range, Taliaferro and Turner (32).

Shasta County: Tridymite has been described by Anderson (35) as a secondary mineral at Bumpass Hell and other hot springs in Lassen Volcanic National Park. It occurs abundantly in vesicular basalts on the road to Terry's Mill, east of Round Mountain.

Tuolumne County: It occurs as very thin, white plates in cavities of an andesite, near Jamestown, Rogers (12).

CRISTOBALITE

Silicon dioxide, SiO_2.

Isometric. Small octahedrons. Dull luster. Color white. H. = 6 — 7. G. = 2.27.

Infusible and insoluble like quartz.

Imperial County: Cristobalite occurs with tridymite and feldspar in an obsidian metamorphosed by hot gases on Cormorant Island, Salton Sea, Rogers (26).

Inyo County: Cristobalite is associated with orthoclase, tridymite, opal, fayalite, and magnetite in the lining of small spherical cavities in obsidian near Little Lake, about 8 miles west of Coso Hot Springs, Rogers (22), (28).

Siskiyou County: Cristobalite occurs with fayalite in lithophysae in spherulitic obsidian, near Canyon Butte in Sec. 13, T. 44 N., R. 43 E., M. D. M.

Tehama County: Cristobalite is a constituent of volcanic rock near Tuscan Springs, Rogers (18).

Tuolumne County: Distinct octahedral crystals of cristobalite occur in augite andesite, near Jamestown, Rogers (18).

OPAL

Silicon dioxide, with a varying amount of water, $SiO_2.nH_2O$.

Amorphous. Colloidal massive; also earthy. Prominent conchoidal fracture. Waxy or glassy luster. Color yellow, brown, green, blue, red, white, gray, and colorless. Streak white. H. = 5½ — 6½. G. = 2.1 — 2.2.

Gives a slight amount of water in a closed tube, otherwise like quartz and chalcedony in its reactions.

Opal is colloidal silica containing from 2 to 10 per cent of water. It occurs as veins, nodules, and coatings.

Common opal occurs in white, yellow, brown, bluish, or greenish masses having a prominent conchoidal fracture.

Fire opal is opal with fire-like reflections.

Hyalite is transparent glassy opal found in the cavities of volcanic rock.

Chrysopal or *prase opal* is a greenish opal found with chrysoprase.

Moss opal is common opal with moss-like inclusions of pyrolusite or chlorite.

Wood opal is petrified wood.

Geyserite is a hydrous silica formed about the vents of geysers and hot springs.

Diatomaceous earth, and *infusorial earth* are deposits of silica formed by diatoms.

Alpine County: Wood opal occurs at Red Lake Peak.

Amador County: Wood opal was found at Volcano; diatomaceous earth in Ione Valley.

Butte County: Wood opal occurs at the Dodson mine.

Calaveras County: Common and hyalite opal have been found at Mokelumne Hill. Wood opal occured at Chile Gulch, Bald Hill, Angels Camp, and other mining camps.

Contra Costa County: Hyalite and common opal have been found on Mount Diablo.

Fresno County: Moss opal has come from the mountains east of Fresno. Diatomaceous earth is reported to occur a few miles southwest of Mendota.

Inyo County: Diatomaceous earth is reported from Independence Valley near the main highway.

Kern County: White opal is found on the summit of Tehachapi Mountain. Fine moss opal occurs 18 miles northwest of Johannesburg. Lewis (33) has reported the occurrence of *'milk opal'* and *'resin opal'* near Rosamond.

Lake County: Large white masses of opal which have replaced basalt occur at Sulphur Bank. Hyalite has come from Middletown and Kelseyville. Diatomaceous earth occurs on the Lost Spring ranch.

Lassen County: Wood opal is found in Surprise Valley. Yellow and white opal have been found near Honey Lake. Diatomaceous earth is found at Butte Lake in Lassen Volcanic National Park, Finch and Anderson (30).

Los Angeles County: Diatomaceous earth occurs at Santa Monica and on Santa Catalina Island. Diatomaceous earth is reported to occur near Bairdstown; in the bluffs 3 miles south of Redondo; at Point Duma, northwest of Santa Monica; at Palos Verdes ranch, San Pedro Hills; and near Acton.

Merced County: Diatomaceous earth of good quality occurs in the hills west of Newman.

Mono County: Diatomaceous earth has come from near Bodie. Geyserite occurs near Casa Diablo, Lewis (33).

Monterey County: Diatomaceous earth occurs 9 miles northwest of Bradley; also near Del Monte.

Napa County: Diatomaceous earth occurs in Friend's Valley west of Calistoga; also 4 miles southeast of St. Helena.

Nevada County: Wood opal occurs at Chalk Bluff, Nevada City, North Bloomfield, and Shelly Hill. Masses of moss opal were found at Newton.

Orange County: Diatomaceous earth occurs near Allison Creek south of El Toro.

Placer County: Wood opal occurs at Gold Run and near Roseville. Diatomaceous earth was found at Dutch Flat.

Plumas County: Wood opal occurs in the Gravel Range.

Riverside County: White hyalite coats the walls of some of the small cavities in the feldspathic pegmatite at Crestmore; dark-brown and black wood opal occurs with calcite in Sky Blue Hill, Eakle (17).

San Bernardino County: Good gem opal is obtained in the Black Mountains about 25 miles north of Barstow; some clear hyalite occurs with it. Common white, colorless hyalite, red, and gem opal occur in cavities in rhyolite 2 miles northeast of Lead Pipe Springs. An opal deposit occurs about 25 miles north of Barstow, in Copper Mountain.

San Diego County: Thin coatings of glassy hyalite occur on the quartz and albite at Rincon, Rogers (10).

San Francisco County: Nodular masses of common opal occur in the serpentine of San Francisco. Moss opal occurs in the Black Hills.

San Luis Obispo County: Diatomaceous earth occurs near Port San Luis, near Arroyo Grande, and near Edna. Occurrences of diatomaceous earth are reported in the mountains back of Pismo, in the hills on the south side of San Luis Valley, in the San Luis Range south of Morro Bay, and in the Salinas Valley as far north as Rinconada.

San Mateo County: Diatomaceous earth occurs at San Gregorio.

Santa Barbara County: A large deposit of diatomaceous earth occurs at Lompoc. Diatomaceous earth also occurs on the southern slope of the Santa Ynez Mountains and near Santa Barbara. It is exposed in the low hills south of Surf and along the coast south of Goleta.

Shasta County: Diatomaceous earth is found in extensive beds along the Pit River and on Hat Creek. A pure white diatomaceous earth occurs a few miles southwest of Bartle in T. 37 N., R. 3 E., M. D. M. Opal occurs with alunite and kaolin in thick and incoherent deposits on the lower flanks of Brokeoff Mountain, H. Williams (32).

Sierra County: Wood opal has come from Downieville.

Siskiyou County: Fire opal has been found near Dunsmuir.

Sonoma County: Wood opal occurs near Santa Rosa; diatomaceous earth about 10 miles north of Petaluma; geyserite at the Geysers. Yellow masses of opal occur on the hills north of Sonoma. Opal of gem quality has been found near Glen Ellen. Fire opal has been found in a clay deposit on the Weise ranch, between Glen Ellen and Kenwood. Infusorial earth occurs as a bed five feet thick 1 mile north of Mark West Springs and 6 miles east of Windsor. A deposit of infusorial earth occurs 2 miles northeast of Agua Caliente. Wood opal in large trees occurs in the Petrified Forest west of Calistoga.

Tehama County: Opal stalactites and stalagmites have been found in a lava tube in basalt on the north side of Inskip Hill, Anderson (30).

Tulare County: Wood opal occurs in Kings River Canyon. Diatomaceous earth occurs near Exeter. Chrysopal or prase opal was found with chrysoprase in the hills east of Visalia and Porterville. Yellow opal occurred with chrysoprase at Yokohl.

Tuolumne County: Wood opal has been found near Columbia.

ARSENOLITE—White Arsenic

Arsenic oxide, As_2O_3.

Isometric, commonly in fibrous crusts and earthy. Octahedral cleavage. Silky or vitreous luster. Colorless or white. H. = $1\frac{1}{2}$. G. = 3.7.

Fusible, yielding white fumes and garlic odor.

Alpine County: Arsenolite is found as an alteration of enargite at the Exchequer mine. Small white octahedrons of arsenolite with realgar occur in the pyrite and enargite at the Monitor mine.

San Bernardino County: Large masses of arsenolite occurred with gold at the Amargosa mine, W. P. Blake (66).

CLAUDETITE

Arsenic oxide, As_2O_3.

Monoclinic. Platy crystals. Perfect clinopinacoidal cleavage. Luster pearly to vitreous. Colorless to white. H. = $2\frac{1}{2}$. G. = 3.85 — 4.15.

Dense white fumes and garlic odor when heated on charcoal.

Imperial County: Kelley (36) has described the occurrence of claudetite crystals in a vein of kaolin, gypsum, halloysite, and sulphur, at a sulphur prospect 6 miles north of the 4 S ranch and $1\frac{1}{2}$ miles west of the Colorado River. Forms: (110), ($\bar{1}01$), ($\bar{1}11$), and (111), Palache (34).

Trinity County: Claudetite occurs as crusts of well-formed monoclinic crystals in the pyrrhotite deposit at Island Mountain.

VALENTINITE

Antimony oxide, Sb_2O_3.

Orthorhombic. In prismatic crystals. Generally columnar masses. Perfect brachypinacoidal cleavage. Adamantine luster. Color snow-white to ash-gray, lemon-yellow. Streak white. H. = $2\frac{1}{2}$. G. = 5.76.

Gives white coating, but no odor on charcoal. Gives no sulphur in closed tube.

Valentinite is an oxidation product of antimony minerals, especially of stibnite.

Kern County: Valentinite occurs with antimony and stibiconite along Erskine Creek, Behre (21).

San Benito County: Lemon-yellow bladed aggregates of valentinite, probably pseudomorphs after stibnite, with cinnabar, quartz, and chalcedony, occur at the Picahotes [Picachos] mine, Rogers (12).

BISMITE—Bismuth Ocher

Bismuth oxide, $Bi_2O_3.3H_2O$.

Hexagonal-rhombohedral. Commonly occurs as an earthy coating. Color yellow to gray. G. = 4.36.

Gives yellow coating on charcoal, which becomes bright-red when fused with potassium iodide and sulphur.

Bismite occurs generally as a yellowish powder or coating on bismuth minerals, especially on native bismuth.

San Diego County: Bismuth ocher was found as a yellow and gray powder with native bismuth at Pala, Kunz (03b). This powder is, according to Schaller (11a), in part bismuth hydroxide, bismuth vanadate, and mixtures of the two. An analysis of the yellow ocher from the Stewart mine showed it to be a mixture of the hydroxide and the vanadate.

		Gangue		H_2O		
Bi_2O_3	V_2O_5	Sol. in HNO_3	Insol. in HNO_3	107°	210°	Ign.
64.43	12.11	2.27	17.63	0.32	0.24	3.43 = 100.43%

An analysis of the gray ocher from the Stewart mine showed it to be probably bismuth hydroxide with the formula $Bi_2O_3.3H_2O$.

		Gangue		H_2O		
Bi_2O_3	V_2O_5	Sol. in HNO_3	Insol. in HNO_3	107°	210°	Ign.
64.9	0.8	9.5	13.5	0.4	0.3	11.4 = 100.8%

Yellow bismite in small irregular particles and minute tabular crystals with the forms (100) and (011) occur at the Victor mine, Rincon, Rogers (10).

ILSEMANNITE

Molybdenum compound, formula uncertain.

Cryptocrystalline. Color blue-black to black.
Soluble in water.

Shasta County: Ilsemannite has been found with molybdenite and pyrite 4 miles west of Gibson, Cook (22).

CERVANTITE

Antimony oxide, $Sb_2O_3.Sb_2O_5$.

Orthorhombic. Acicular crystals rare; usually a crust or powder. Sometimes massive. Color yellow to white. H. = 4½. G. = 4.

Infusible. The antimony oxide coating on charcoal is obtained only with the aid of a flux like sodium carbonate.

Cervantite occurs as an alteration product of stibnite or native antimony.

Inyo County: Massive yellow cervantite has been found at the Lottie mine, Wild Rose district, and at the St. Ignacio mine.

Kern County: Cervantite occurred with stibnite at the San Emidio mine.

STIBICONITE

Hydrous antimony oxide, $H_2Sb_2O_5$.

Mostly amorphous. Massive or as a crust or powder. Color yellowish-white. H. = 4 — 5½. G. = 5.1 — 5.28.

Reacts like cervantite, but yields water in a closed tube.

Occurs as an alteration product of stibnite or native antimony.

Kern County: Stibconite has been found with native antimony at Little Caliente Springs and on Erskine Creek.

PARTZITE

Hydrous oxide of antimony, copper and other bases.

Massive. Color blackish-green to black. H. = 3 — 4. G. = 3.8.

Stetefeldtite is similar to partzite with more silver.

Mono County: Partzite was found with argentiferous galena in veins in the Kerrick, Comanche, Diana, and Comet mines of the Blind Spring Hill district and described as a new mineral and analyzed by Arents (67). It was considered, however, by W. P. Blake (67a) to be a mechanical mixture of the hydrous oxide of antimony with other metallic bases.

Sb_2O_3	Cu_2O	Ag_2O	PbO	FeO	H_2O
47.65	32.11	6.12	2.01	2.33	8.29 = 98.51%

A specimen labeled "stetefeldtite" has come from the Giant mine.

CUPRITE—Red Copper Ore

Cuprous oxide, Cu_2O.

Isometric. Small cubes and octahedrons. Generally massive. Brittle. Adamantine to submetallic luster. Color red. Streak brownish-red. H. = 3½. G. = 5.85 — 6.15.

Mixed with sodium carbonate, it is easily reduced on charcoal to metallic copper. Soluble in concentrated hydrochloric acid, and when cooled and diluted with cold water, yields a heavy white precipitate of cuprous chloride.

Cuprite is an important ore of copper. It occurs in most of the copper localities as a secondary mineral in the oxidized portions of the deposits. Massive specimens have come from various counties but no large bodies of cuprite are known in California.

Chalcotrichite is a long hair-like variety.

Calaveras County: Masses of cuprite with chalcopyrite are occasionally found at Copperopolis and Campo Seco. It is mentioned by Silliman (67a) from Quail Hill.

Colusa County: Cuprite occurred at the old Candace and Union mines. The capillary variety, chalcotrichite, was found with massive cuprite in the Lion mine.

Del Norte County: Masses of cuprite with native copper occurred at the Pearl copper mine. Cuprite is common in the Rockland district.

El Dorado County: Cuprite occurred with malachite, chalcopyrite, and native copper at the Cambrian mine.

Fresno County: It was prominent in the Gordon-Fresno copper mine.

Humboldt County: Cuprite occurs with native copper and malachite on Horse Mountain. It was found with melaconite, chalcocite, and malachite on the Fields Lebanon property, Red Cap Creek.

Kern County: Cuprite occurred in the Greenback mine, Woody district, 30 miles northeast of Bakersfield, Storms (13).

Lassen County: Cuprite occurs in the Lummis mine.

Modoc County: Excellent specimens of cuprite with malachite, native copper, and chrysocolla have come from the Christy mine, Fort Bidwell, and from the Leitz mine, 7 miles south of Fort Bidwell.

Mono County: Massive cuprite was found at the Eclipse, Kerrick, and Mammoth mines; also near Lundy with cerargyrite and chrysocolla. It occurred with native copper at the Cavin mine, Copper Mountain, 22 miles southwest of Bodie. Cuprite is found with malachite and melaconite in the Detroit Copper mine, Jordan district, about 6 miles northeast of Lundy.

Napa County: Cuprite was found near Calistoga and St. Helena, some of it the chalcotrichite variety.

Nevada County: Cuprite occurs with chalcocite and native copper at Meadow Lake; with chalcocite and malachite at the Oro Grande mine.

Placer County: Massive cuprite occurs near Lincoln; it is found with chalcopyrite at the Elder mine.

Plumas County: It occurs in Light's Canyon; with native silver at the Pocahontas mine, Indian Valley.

Riverside County: It occurred in quantity at the Red Cloud mine, Chuckawalla Mountains.

San Bernardino County: Massive cuprite was found in Holcombe Valley; common at the Copper World mine, Clark Mountain.

Shasta County: Cuprite has been found at the Peck, Afterthought, Copper City, Greenhorn, and other mines of this county.

Trinity County: It occurs massive at Trinity Center.

Tulare County: Cuprite occurs in the Mineral King district.

Tuolumne County: It was found at Whiskey Hill, Silliman (67a).

PERICLASE

Magnesium oxide, MgO.

Isometric. Cubes and octahedrons. Cubic cleavage. White or colorless. H. = 6. G. = 3.67 — 3.90.

Infusible, but completely soluble. Ammonia and sodium phosphate added to hydrochloric acid solution precipitates magnesia. Alters to brucite.

Riverside County: Periclase was found in the city quarry at Riverside, Rogers (18a). It was later reported by Rogers (29) from the Wet Weather quarry at Crestmore.

MASSICOT

Lead monoxide, PbO.

Orthorhombic. Usually in scales or scaly masses. Color brownish orange-red. Soft. G. = 9.29.

Fuses easily to a yellowish glass. Easily reduced on charcoal to metallic lead; yielding yellow coating.

San Bernardino County: Crystalline scaly masses of massicot with litharge occur on Cucamonga Peak, and were described by Larsen (17a).

LITHARGE

Lead monoxide, PbO

Tetragonal. Scaly masses. Color lemon-yellow to orange-yellow. H. = 2. G. = 9.13.

Fuses easily to a yellow glass. Easily reduced on charcoal to metallic lead, and gives yellow coating.

San Bernardino County: Litharge occurred with massicot on Cucamonga peak, Larsen (17a).

TENORITE—Melaconite

Cupric oxide, CuO.

Triclinic. In minute scales; also as an earthy powder; massive. Metallic to dull luster. Color and streak black. H. = 3 — 4. G. = 5.82 — 6.5.

Same reactions as obtained from cuprite. Distinguished by color.

Calaveras County: Tenorite is a common alteration product of chalcopyrite at Copperopolis and Campo Seco. Large nodular masses of it have come from the Satellite mine. It is found with malachite at the Telegraph mine, Hog Hill.

Colusa County: Tenorite was found in serpentine with native copper and cuprite at the Gray Eagle mine.

Del Norte County: It occurred with the chalcopyrite at the Alta and Pearl mines.

Inyo County: Tenorite occurred with chrysocolla, azurite, and malachite in the Greenwater district.

Mono County: It was found with cuprite at the Detroit copper mine.

Nevada County: Tenorite occurred at the Excelsior mine.

Shasta County: It occurs at the Afterthought and other chalcopyrite mines of this county.

MONTROYDITE

Mercuric oxide, HgO.

Orthorhombic. Prismatic crystals. Perfect pinacoidal cleavage. Brilliant luster. Color and streak deep-red. H. = $1\frac{1}{2}$ — 2.

Volatile.

San Mateo County: Montroydite has been found in long prismatic and bent crystals with eglestonite, calomel, native mercury, and cinnabar in joints and fissures in a siliceous rock replacing serpentine about two miles west of Redwood City, Woodhouse (34).

HEMATITE GROUP

CORUNDUM

Aluminum oxide, Al_2O_3.

Hexagonal-rhombohedral. Prismatic crystals and massive. Brittle; when compact very tough. Adamantine to vitreous luster. Color generally bluish-gray; also blue, red, yellow, brown, gray. Streak uncolored. H. = 9. G. = 3.95 — 4.10.

Infusible and insoluble. Fragments moistened with cobalt nitrate and intensely heated assume a sky-blue color.

Corundum-bearing rocks are rare in the State and no workable deposits of this useful mineral are known. The gem varieties, ruby and sapphire, have not been found in good clear crystals.

Butte County: A few sapphires are said to have been found with diamonds in stream gravels in this county.

Los Angeles County: The first mention of corundum in the State was of some sapphire-blue pebbles found in San Francisquito Pass, W. P. Blake (66).

Mono County: Coarse nodular masses of corundum occur with the andalusite at the mine of Champion Sillimanite, Incorporated, on the western slope of the White Mountains, 7 miles east of Mocalno, Kerr (32).

Plumas County: Large violet-blue crystals occur in the plumasite of Spanish Peak, Lawson (03).

Riverside County: Large crystals of corundum have been found near the summit of the San Jacinto Mountains.

San Bernardino County: Corundum was found in the Kingston Range, Kunz (05). Pale-rose to deep-lilac crystals of corundum occur in metamorphosed limestone in Cascade Canyon, a branch of San Antonio Canyon, in the San Gabriel Mountains, Louderback and Blasdale (10), Merriam and Laudermilk (36).

San Diego County: It is a constituent of the dumortierite schist of Dehesa, Schaller (05). Pink and gray crystals of corundum occur in a vein with garnet in mica schist on the northern slope of the San Miguel Mountains, 26 miles east of San Diego. Blue corundum is reported from Tule Mountain, north of Jacumba.

HEMATITE—Red Ocher

Iron oxide, Fe_2O_3.

Hexagonal-rhombohedral. Crystals, compact massive, lamellar, granular, micaceous, and earthy. Luster metallic, submetallic, or dull. Color black, red, brown. Streak red and reddish-brown. $H. = 5\frac{1}{2} - 6\frac{1}{2}$. $G. = 4.9 - 5.3$.

Gradually acted on by strong acids; ammonia precipitates ferric hydrate. Becomes magnetic on heating. Gives little or no water in closed tube.

Hematite is the chief ore of iron. Crystalline black masses of hematite are found with metamorphic and intrusive igneous rocks. The flaky variety, *specular hematite,* often termed 'specularite,' is a common constituent of the crystalline rocks of the State. Red hematite mixed with brown limonite forms the capping of many iron sulphide deposits.

Martite is a pseudomorph of hematite after magnetite. Much of the magnetite of the State shows a change into hematite and martite is common in the magnetite-hematite deposits.

Alameda County: Massive red earthy hematite mixed with limonite forms the capping of the pyrite body at Leona Heights.

Alpine County: Massive black hematite occurs at Monitor.

Amador County: Impure hematite occurs 2 miles west of Ione, and also half a mile northwest of Clinton.

Butte County: It is common in the gravels at Magalia, Butte Creek, Oroville, and Stirling City. Specular hematite is found at Bangor.

Calaveras County: Hematite was found at Douglas Flat, Murphy, Wallace, and Quail Hill.

Colusa County: Good massive hematite occurs 40 miles west of Willows. A red hematite suitable for mineral paint occurs in a deposit 4 miles southwest of Lodoga.

Del Norte County: It was found at the Kelsey Tunnel, 14 miles southeast of Crescent City.

El Dorado County: Hematite occurred in masses at Shingle Springs. It also occurred in the gravels at Diamond Springs, Green Valley, and Virner.

Humboldt County: It occurs in a large vein 3 miles south of Centerville. Red ocherous hematite is found near Garberville and also 8 miles from Ferndale. Soft red ocherous hematite occurs on Jones Creek, 2 miles northeast of Arcata. Specular hematite occurs in the Humboldt mine at Orleans. Massive red hematite occurs on Rainbow Ridge.

Inyo County: Massive specular hematite occurs at the Defiance mine. Hematite is also found in Owens Valley, Hanks (84). A large deposit of specular hematite is found near Alvord Station. The specular variety is found in large masses in the Inyo Mountains, 7 miles east of Kearsarge. Red hematite occurs five miles north of Shoshone. Fine specular hematite occurs in the Grapevine Range.

Kern County: Hematite occurs at Cane Springs and Ricardo. A deposit of specularite occurs in mica schist at the foot of Mount Breckenridge, about 20 miles north of Caliente. Red ocherous hematite occurs in the Red Rock district.

Lake County: Massive red hematite occurs near Glenbrook. A deposit of red ocherous hematite occurs in Jerusalem Valley, near Dollar Springs. Pseudomorphs of hematite after marcasite have been described from the Baker mine, 6 miles from Lower Lake, by Rogers (10a).

Lassen County: Excellent specimens of specular hematite have come from near Susanville.

Marin County: Massive specimens of hematite have come from the Mailliard ranch, about 2 miles southwest of San Geronimo.

Mendocino County: Large crystalline masses of hematite occur 7 miles east of Round Valley on the Eel River. Red ocherous hematite is found in Anderson Valley and near Covelo.

Mono County: It is common in the Blind Spring Hill district. Abundant masses of specular hematite occur in the andalusite mass on the western slope of the White Mountains, Knopf (17a).

Napa County: Massive red hematite occurs near St. Helena, at White Sulphur Springs, and Blaisville. Red and brown masses of hematite and limonite occur at the Sterling Iron mine, St. Helena.

There is a red ocherous hematite deposit on Benoli Mountain, 2 miles south of Calistoga.

Nevada County: It was found with gold at Meadow Lake, Lindgren (93). Small deposits of hematite occur at Indian Springs and at Newtown.

Orange County: It was observed at Fullerton.

Placer County: Hematite occurs with magnetite at the Hotaling deposit about 6 miles north of Auburn. Small amounts of it occur at Clipper Gap, Red Hill, and near Weimar.

Plumas County: Hematite occurs with magnetite near Crescent Mills; at Mumford's Hill, Light's Canyon, Genesee Valley, and Nelson Point. Foliated masses of specular hematite occur in quartz on the north side of the Diamond Range. Specular hematite mixed with magnetite occurs as a vein very close to the Diadem lode. Black masses of hematite occur with magnetite near Moonlight, 11 miles north of Taylorville. Hematite is common at the Engels copper mine.

Riverside County: Considerable hematite is associated with, and has been formed from magnetite, at the extensive deposits in the Eagle Mountains. The specular variety associated with green epidote is common in the Monte Negro district. Some of the cellular cavities formed by leaching out of brucite are filled with red hematite, at Crestmore, Eakle (17).

San Benito County: It was reported to occur at the old Quilty Iron mine.

San Bernardino County: The numerous iron deposits of the Mojave Desert have hematite and magnetite in heavy black masses. The deposits near Dale, on Iron Mountain, in the Kingston Range, at Cave Canyon, Newberry, on Providence Mountain near Kelso, and elsewhere in the county, are massive hematite after magnetite, or martite. A soft red ocherous hematite occurs in the Calico district, 5 miles west of Yermo. Hematite is found massive on Sheephole Mountain.

San Diego County: Black massive hematite occurs in Eagle Peak Canyon.

San Joaquin County: Earthy red hematite as shale occurs at the Ladd manganese mine.

San Luis Obispo County: An extensive deposit of hematite with limonite occurs in the Irish Hills southwest of San Luis Obispo, Franke (35).

Shasta County: The Redding or Pit River deposit of hematite has been utilized at the electric smelting furnace at Heroult. Thick deposits of earthy hematite and limonite cap the pyrite beds of this county.

Siskiyou County: The gravels of the Shasta River contain specular hematite.

Sonoma County: Deposits of hematite are reported near Fort Ross and near the west fork of the Gualala River. Hematite occurs on the Lancaster ranch, east of Fisk's Mills. Siliceous hematite occurs on Porter Creek, about 10 miles southwest of Healdsburg.

Stanislaus County: Foliated hematite occurs near La Grange.

Tehama County: Deposits of hematite occur at Beegum.

Trinity County: It is found in the sands at Trinity Center. Specular hematite occurs near Burnt Ranch.

Yuba County: It is found in the sands of the Brownsville district.

ILMENITE—Menaccanite

Oxide of iron and titanium, $FeTiO_3$.

Hexagonal-rhombohedral. Plates, massive, in rounded pebbles and grains. Submetallic luster. Color black. Streak dark-brown to black. H. = 5 — 6. G. = 4.5 — 5.

Magnetism usually increased by heating. When ilmenite is fused with sodium carbonate and the flux dissolved in hydrochloric acid, the solution turns reddish or bluish violet when reduced with metallic tin.

Ilmenite resembles hematite and magnetite so closely that it is not often differentiated from them. The black beach sands and the black-sand concentrates in the gold fields contain much ilmenite in small grains and rolled pebbles. In most of the localities given below it exists in the sands.

Amador County: Ilmenite occurs near Volcano.

Butte County: It occurs at Oroville, Cherokee, Little Rock Creek, Brush Creek, and Inskip.

Calaveras County: Ilmenite occurs in considerable amounts at San Andreas, Murphy, and Wallace.

Del Norte County: It occurs at Crescent City.

El Dorado County: It occurs in the Brownsville district, at Green Valley, Placerville, and Grizzly Flats. It occurs at Georgetown, W. P. Blake (58).

Fresno County: Ilmenite occurs with rutile, near Friant.

Humboldt County: It occurs at Upper Gold Bluff.

Imperial County: Massive ilmenite occurs near Niland.

Kern County: It is an important constituent of the black sands at Vaughn.

Los Angeles County: Ilmenite occurs in the beach sands at Ocean Park and Hermosa Beach. Important deposits of ilmenite occur in the San Gabriel Mountains.

Madera County: Plates of ilmenite are found with pyrophyllite and quartz at Beach Creek on the North Fork of San Joaquin River, and platy masses of ilmenite occur just west of Agnew Pass, Erwin (34).

Mariposa County: Ilmenite occurs near Princeton, and as crystals in dolomite near Mariposa.

Mono County: Minute flakes of ilmenite occur in andalusite at the mine of Champion Sillimanite, Incorporated, on the western slope of the White Mountains, 7 miles east of Mocalno, Woodhouse (36).

Nevada County: Ilmenite occurs at Rough and Ready, Nevada City, North Bloomfield, and Relief Hill.

Orange County: Ilmenite occurs at Fullerton.

Placer County: Ilmenite occurs at Gold Run.

Plumas County: Ilmenite occurs at Spanish Ranch, Crescent Mills, La Porte, and Nelson Point. It is intergrown with hematite and magnetite at Engels. Good crystals have been found at Genesee.

San Bernardino County: Ilmenite occurs near Needles.

San Luis Obispo County: It is found in the beach sands of the county.

Santa Barbara County: It occurs at Point Sal.

Santa Cruz County: It is a constituent of the black sands at Aptos, Hess (27).

Shasta County: It is found at Round Mountain, French Gulch, and Redding.

Siskiyou County: It occurs in the sands of Jackson Creek, Happy Camp, Forks of the Salmon, Sawyers Bar, Scott River, and Shasta River.

Trinity County: It occurs at Junction City, Carrville, Minersville, and on the Trinity River.

Tulare County: It occurs with specular hematite and magnetite, near Orosi.

Tuolumne County: It occurs at American Camp.

Yuba County: It occurs at Marysville, Brownsville, Yuba River, Strawberry Valley, Indian Hill, and Oregon House.

SPINEL GROUP

SPINEL

Magnesium, aluminum oxide, $MgO.Al_2O_3$.

Isometric. Usually in octahedrons; rounded grains. Brittle. Vitreous luster. Color ruby-red, blue, green, brown, black. Streak white. H. = 8. G. = 3.5 — 4.1.

Infusible. Fused with sodium carbonate, dissolved in hydrochloric acid, the solution yields aluminum hydroxide on the addition of ammonia, and white magnesium phosphate on the further addition of sodium phosphate, thus distinguishing it from corundum.

Spinel occurs only as a rock constituent and exists in some of the gold-placer sands as ruby-red grains resembling red garnet.

Picotite is a brown spinel containing chromium and iron; it occurs in the serpentine rocks.

Pleonaste is a dark-green iron-magnesium spinel.

Butte County: Small crystals of ruby spinel have been found in the rock of the diamond mine near Oroville.

Humboldt County: Ruby spinel occurs in the beach sands at Gold Bluff.

Lassen County: Brown octahedral crystals of picotite have been found in quartz basalt at Cinder Cone, Lassen Volcanic National Park, Finch and Anderson (30).

Placer County: Picotite has been found at Rocklin, Hanks (84).

San Bernardino County: Black spinel occurs in the basalt flows south of Pipes Canyon, Secs. 21 and 22, T. 1 N., R. 4 E., S. B. M., in basalt near Quail Springs, T. 1 S., R. 7 E., S. B. M.

San Diego County: Blue spinel was reported to occur in the Mack mine near Rincon; the deep-green, pleonaste variety, in small octahedrons, occurs there with garnet, Rogers (10).

San Luis Obispo County: Ruby spinel has been observed near San Luis Obispo, Kunz (05).

Siskiyou County: Picotite occurs in the basalts of Mount Shasta, Hanks (84).

Tulare County: Granular green spinel occurs in metamorphosed serpentine on the southwest side of Rocky Hill and in metamorphosed basic volcanic rocks on the southern slope of Woodlake Mountain.

MAGNETITE

Iron oxide, Fe_3O_4.

Isometric. Octahedral crystals, compact and granular massive. Metallic luster. Color iron-black. Streak black. H. = $5\frac{1}{2}$ — $6\frac{1}{2}$. G. = 5.1.

Strongly magnetic. Soluble in hydrochloric acid, and reddish ferric hydrate precipitated on the addition of ammonia. Distinguished from hematite by streak and magnetism.

Magnetite is one of the most abundant of the iron minerals, and good deposits of it occur in the State. It is a constituent of most igneous rocks and in such condition exists in all of the counties. It forms the bulk of the black sands. Most magnetite occurs with the metamorphic schists and gneisses, and in igneous rocks. It often occurs along the contact of igneous intrusions through metamorphic or sedimentary rocks. Some magnetite is titaniferous, grading toward ilmenite.

Lodestone is a variety possessing polarity; it forms a natural magnet.

Alameda County: Octahedral crystals occur in the schists of North Berkeley.

Butte County: Magnetite is abundant in the drift workings at Magalia, in the gravels on Butte Creek, and in the dredging sands at Oroville. It is found in the concentrates at Stirling City, Little Rock Creek, Brush Creek, Lovelock, and Inskip. Masses of it occur near Oroville.

Calaveras County: It is found in the concentrates at Douglas Flat, San Andreas, Murphy, and Wallace. Massive magnetite occurs on Carson Hill.

Del Norte County: It is found at Crescent City, Gilbert Creek, and Smith River. Masses of pure magnetite occur in the French Hill mining district.

El Dorado County: Magnetite occurs massive and as fine octahedrons in chlorite about 2 miles northeast of Shingle Springs. Lodestone has been found at Colma. Magnetite is common in the concentrates at Virner, Green Valley, Grizzly Flats, the Reliance mine, and in the Brownsville district. It occurs with galena, chalcopyrite, calcite, quartz, and garnet as a contact deposit at the Lilyoma mine, Pilot Hill. Large masses of magnetite occur near Volcanoville, W. P. Blake (58). Masses of magnetite are found near Fallen Leaf Lake.

Fresno County: Lodestone has been found at the Sparkling Iron mine, Kings Creek district. Octahedral crystals associated with bornite occur in the Uncle Sam mine on Crown Creek opposite Tehipite Dome, the Kings River. Pure masses of magnetite occur in Cinnamon Bear district, Pine Flat.

Humboldt County: The greater part of the black constituent of the beach sands at Gold Bluff and Upper Gold Bluff is magnetite. It is common at Orleans and Trinidad.

Imperial County: It is found massive near Palo Verde.

Inyo County: Large deposits of magnetite are reported to occur in the Olancha district near the Haiwee Dam.

Kern County: It is abundant in the black concentrates at Ricardo, Kane Springs, and Vaughn. Granular masses of magnetite occur in the San Emigdio mining district. Magnetite occurs with mica schist, 1½ miles south of Woody.

Los Angeles County: Several deposits of titaniferous magnetite occur in T. 4 N., R. 14 W., S. B. M., south of Soledad Canyon, Tucker (27). W. J. Miller (31), (34), has described the occurrence of massive titaniferous magnetite in gabbro and diorite 1 mile southwest and 3 miles east of the Monte Cristo Gold mines near the headwaters of Mill Creek in the San Gabriel Mountains. It occurs in the black sands at Ocean Park, and with garnet in the black sands of Santa Monica Bay.

Madera County: Large deposits of magnetite occur on the western slope of Iron Mountain in the Minaret district, Weeks (15), Erwin (34). Deposits of it occur on the western slope of Mount Raymond.

Mariposa County: Masses of magnetite occur at the base of Mount Hoffman.

Modoc County: It is found in the drift and black sands of the Pit River.

Mono County: It is found massive in the Benton, Bodie, and Lundy districts, Whiting (88).

Nevada County: Deposits of magnetite occur about 1 mile west of Newtown, and about 4 miles south of Indian Springs at the contact between granodiorite and diabase. Magnetite is common in the concentrates at Nevada City, Grass Valley, North Bloomfield, Relief Hill, and Rough and Ready. A small deposit of magnetite occurs in place at Diamond Creek, about 1 mile east of the Omaha mine.

Orange County: It is found in the sands at Fullerton.

Placer County: A deposit of magnetite which was worked in 1881-1886 by blast furnace, occurs at Hotaling, 5 miles west of Clipper Gap, on contact between diabase and quartzite. Octahedrons are common at Forest Hill. It is common in the black sands and concentrates at Butcher Ranch, Michigan Bluff, Gold Run, East Auburn, in Blue Canyon, and on the North Fork of American River.

Plumas County: Magnetite is common at Spanish Ranch, Genesee, La Porte, Nelson Point, Crescent Mills, and on Rock Island Hill, but only in small amounts. A large body of the ore occurs close to the west shore of Wades Lake. It is found with hematite at Moonlight. Magnetite is common in the rocks at Engels, sometimes intergrown with ilmenite, Knopf and Anderson (30).

Riverside County: One of the largest deposits of iron in the State occurs on the Eagle Mountains. It is magnetite-hematite or martite ore.

Sacramento County: It occurs in the black sands at Michigan Bar.

San Benito County: A large deposit of magnetite is reported near Hollister.

San Bernardino County: Magnetite occurs at the Iron Age iron-ore deposit 6 miles east of Dale, Harder and Rich (10). It occurs at Owl Holes, on the Kingston Range, at Cave Canyon, Garlic Springs, Newberry, and on Providence Mountain. Massive lodestone exhibiting strong polarity has come from a deposit 30 miles southeast of Daggett.

San Francisco County: It is a constituent of the beach sands.

San Luis Obispo County: It is common at La Panza.

Santa Barbara County: It is common in the beach sands at Point Sal.

Santa Cruz County: Magnetite makes up 25 to 50 per cent of the stratified beach sands 2 miles southeast of Aptos, where an experimental plant has been operated for the production of sponge iron, Laizure (26).

Shasta County: A large deposit of magnetite at Heroult, on contact between diabase and slate, was worked by electric smelter. Magnetite occurs near Baird, with hematite at Iron Mountain, and at most of the copper mines. It is found in the sands at French Gulch, Redding, and Round Mountain. It occurs on contact between diabase and carboniferous limestone at Gray Rock and on the McCloud River. A large deposit of magnetite occurs between quartz diorite and limestone about 5 miles east of Pitt on the Sacramento Valley and Eastern Railroad. It occurs as a contact mineral with pyrrhotite and chalcopyrite at the Black Diamond mine.

Sierra County: Large beds of magnetite are reported in this county, W. P. Blake (66). Perfect octahedrons have come from Forest City. A massive deposit of magnetite occurs south of Lake Hawley in the Calaveras formation, and also southeast of Spencer Lakes.

Siskiyou County: It is common in the black sands at Happy Camp, Seiad, Cecilville, Forks of the Salmon, Sawyers Bar, Scott River, Oro Fino, Castella, Shasta River, Beaver Creek, Henley, and Klamath River. Lodestone occurs near Weed.

Tehama County: Titaniferous magnetite occurs in the Beegum district.

Trinity County: It is found in the black sands at Trinity Center, Douglas City, Junction City, Carrville, Minersville, and along the Trinity River. Massive magnetite occurs at Douglas City, and on the northwest side of Chauckelulla Mountain.

Tulare County: A massive deposit of magnetite occurs at New Pass, W. P. Blake (58). It is found massive near Three Rivers and on Greenhorn Mountain.

Tuolumne County: It occurs in the black sand concentrates at all of the mines.

Yuba County: It is common at Marysville, Brownsville, Strawberry Valley, Indian Hill, Oregon House, Camptonville, and on the Yuba River. It occurs massive with hematite 4 miles from Clipper Mills.

CHROMITE

Oxide of chromium and iron, $FeCr_2O_4$.

Isometric. In octahedrons. Generally massive; fine granular to compact. Brittle. Metallic luster. Color black. Streak brown. H. = 5½. G. = 4.1 — 4.9.

Infusible. Gives an emerald-green bead of chromium with borax. Insoluble.

In much of the chromite of the State magnesium replaces the iron, forming magnesian chromite. The mineral is often found as large boulder-like or irregular masses, and is abundant in the serpentine areas of the State, Diller (21). Its distribution and production have been described in detail in Bulletin No. 76 of the State Division of Mines.

Alameda County: Pockets of massive chromite, sometimes coated with zaratite, occur at the Mendenhall mine and other mines about 16 miles southeast of Livermore, in the Cedar Mountain district. Kramm (10) has analyzed chromite from Cedar Mountain:

Cr_2O_3	Al_2O_3	FeO	MnO	MgO	CaO	SiO_2	H_2O
55.74	18.79	16.99	tr.	8.41	tr.	none	0.09 = 100.02%

Amador County: Chromite is found near Jackson; deposits occur near Ione; about 8 miles northeast of Carbondale; 5 miles southwest of Plymouth, near Willow Creek.

Butte County: It is a constituent of the black sands at Magalia, Oroville, Cherokee, Buchanan Hill, Lovelock, and Pentz. It occurs

massive near Forbestown. Deposits of chromite occur about 1 mile southwest of Big Bar; 1 mile east of Yankee Hill; 5 miles southwest of Magalia; 1 mile north of Woodleaf; east of Brush Creek; near Twin Cedars, 6 miles east of Paradise; 2½ miles northeast of Forbestown. Small bodies of chromite occur at the Powell manganese mine, 1 mile north of Clipper Mills, and at Pentz.

Calaveras County: It occurs in the serpentine about 5 miles east of Valley Springs. It is found in the concentrates at Forest Gulch. Deposits of chromite occur near Copperopolis; about 7 miles west of Angels Camp; 4 miles west of Fostoria; 5 miles southwest of Valley Springs; 10 miles northeast of Angels Camp; 14 miles east of Milton. Deposits of it occur on the Tower ranch, 9 miles east of Milton, and on the Wright ranch, in Salt Spring Valley, 10 miles northeast of Milton.

Colusa County: It is found massive at Newville. It occurs near Stonyford; near Wilbur Springs; 1½ miles northwest of Cook Springs.

Del Norte County: Chromite is found in the black sands of the Smith River, on Gilbert Creek and at Crescent City. Good deposits of it occur on Rattlesnake Mountain, 20 miles east of Crescent City. Deposits of chromite occur in lenses 8 feet thick at French Hill, near Smith River.

El Dorado County: Chromite occurs near Coloma and at Shingle Springs; 3 miles northeast of Georgetown, near Latrobe; 2 miles south of Georgetown; in Marble Valley, near Clarksville. Analysis of chromite from the Donnelly deposit, 10 miles northeast of Folsom, gave:

Cr_2O_3	SiO_2	FeO	Al_2O_3	MgO	CaO	Ign.
46.52	6.60	17.63	11.66	15.80	1.23	0.50 = 99.94%

Large deposits of granular masses of chromite occur in serpentine at Flagstaff Hill, 8 miles south of Auburn. Chromite occurs at the Pilliken Chrome mine, 10 miles northeast of Folsom. A large deposit of chromite occurs on the Williamson property, 6 miles east of Shingle Springs.

Fresno County: Deposits of chromite occur in the southwestern part of the county in the Mount Diablo Range, and in the hills east of Fresno, from Letcher to Piedra. Deposits of it occur in Watt Valley, on Hog Mountain, and at Pine Flat.

Glenn County: Deposits of chromite occur near Millsaps; at Bedford, 5 miles east of Chrome; about 6 miles east of Newville; near Orland.

Humboldt County: It is a constituent of the beach sands at Gold Bluff, and of the concentrates at Orleans and Trinidad. It occurs

massive near Blocksburg. Small masses of chromite occur on Horse Mountain; and in the serpentine east of Orleans. Chromite is found on the Hoopa Valley Indian Reservation.

Kern County: Small deposits of chromite occur on the Kern River.

Kings County: Masses of chromite have been found near Parkfield.

Lake County: Pockets of chromite occur on the Pardee ranch, near Middletown. Masses of it have been found in the mountains near Adams and Siegler Springs. A large body of chromite occurs 3 miles northeast of Hullville. Chromite is reported from Jerusalem Valley.

Los Angeles County: Chromite has been reported near Acton; also near Harold Station.

Madera County: It is found near Madera in masses coated with zaratite.

Marin County: It occurs on the Mailliard ranch near San Geronimo, about 8 miles northwest of San Rafael.

Mariposa County: A deposit of chromite occurs near Pleasant Valley Station.

Mendocino County: It is found coated with green uvarovite garnet about 11 miles north of Willits. It has been found at several points in the hills west of the Russian River. It occurs about 1½ miles west of Ukiah, on Red Mountain, and in Potter Valley.

Monterey County: Chromite is common in small masses in the serpentine of this county, and specimens have been analyzed, Goldsmith (73a).

Cr_2O_3	Al_2O_3	Fe_2O_3	MgO	CaO	SiO_2	
52.12	2.18	15.24	12.29	5.65	12.12 = 99.60%	G. = 4.1647.

Masses of chromite occur about 3 miles east of Parkfield on Table Mountain.

Napa County: Small bodies of chromite have been found near Knoxville. It occurs 8 miles northwest of Monticello.

Nevada County: Fine octahedrons occur in the serpentine near Indian Springs. Chromite is found in the concentrates at Rough and Ready, North Bloomfield, and Relief Hill. Chromite occurs in serpentine with uvarovite and chrome chlorite at the Red Ledge mine, 2 miles south of Washington. Masses of it occur near Grass Valley.

Placer County: A deposit of chromite occurs in serpentine near Green Valley below Towle, and also near Auburn. Chromite is found in the black sands of the North Fork of American River, of Blue

Canyon, at Loomis, and at Michigan Bluff. Small deposits of it occur about 2½ miles from Dutch Flat; near Weimar; 4 miles from Colfax; in the Iowa Hill district, and on Forest Hill Divide. Large deposits of chromite 7 miles south of Newcastle occur as nodular masses coated with good crystals of uvarovite, penninite, and kämmererite. Lenticular masses of it occur in serpentine on the Scott property 2 miles east of Towle, and in Green Valley, 9 miles southeast of Towle.

Plumas County: It is common at Rock Island Hill, La Porte, and in Meadow Valley as concentrates. Bodies of chromite occur 6 miles south of Quincy, also 3 miles southwest of Crescent Hill, 2 miles north of Spanish Ranch, and three-fourths of a mile southwest of Meadow Valley.

Sacramento County: It is a prominent constituent of the black sands at Michigan Bar. Massive chromite occurs at Nigger Hill near Folsom.

San Benito County: Massive specimens of chromite coated with zaratite have come from near Hollister. Chromite is found in serpentine near New Idria.

San Luis Obispo County: Chromite is mined southeast of San Luis Valley on the slope of the Santa Lucia Range, Harder (10a). It occurs at the London mine, 4½ miles northeast of San Luis Obispo. It is found at the head of San Carpojaro Creek and at La Panza. The chromite from the Pick and Shovel mine on Chorro Creek, 6 miles northeast of San Luis Obispo, has been analyzed, Pemberton (91).

Cr_2O_3	Al_2O_3	Fe_2O_3	MgO	FeO	MnO	SiO_2	H_2O
52.68	11.40	3.52	16.23	11.77	0.15	3.40	0.94 = 100.09%

San Mateo County: It is common in the beach sands of the county. A few scattered masses of chromite occur near Crystal Springs Lake, west of San Mateo.

Santa Barbara County: A small deposit of chromite occurs in the hills southwest of Point Sal; another occurs in the San Rafael Mountains south of Santa Ynez.

Santa Clara County: It is found in small masses in the serpentine near Los Gatos; near New Almaden, and in dunite southwest of Gilroy. Small amounts of chromite have been found in the hills east of Alum Rock Park, Franke (30). A small deposit of chromite occurs on the Righetti ranch, 3 miles east of Coyote Station.

Shasta County: It occurs at French Gulch and in the black sands of the Sacramento River. Massive chromite occurs near Castella. A

series of lenses of chromite in a shear zone in serpentine occur north of Shotgun Creek. A large body of chromite occurs on Little Castle Creek. Several bodies of it occur 3 miles east of Sims Station.

Sierra County: It occurs as pebbles in gravels at Howland Flat; also in Goodyear Creek near Downieville.

Siskiyou County: A good deposit of chromite near Dunsmuir is coated with kämmererite. Massive chromite occurs near Callahan coated with uvarovite and zaratite. It is common as grains in the concentrates at Callahan, Grouse Creek, Happy Camp, on the Scott River, and Beaver Creek. Deposits of chromite occur near Gazelle and on top of the Forest Mountains. It is found massive near Edgewood. Banded chromite ore in dunite near Seiad Valley has been described by Rogers (31). Chromite from a prospect on Seiad Creek, 5 miles above its junction with the Klamath River, has been analyzed by Milton, Johnston (36).

Cr_2O_3	Al_2O_3	Fe_2O_3	FeO	MnO	NiO	MgO	CaO	SiO_2
57.92	5.84	6.40	14.83	0.25	0.06	13.12	0.26	1.29 = 99.97%

Solano County: Small amounts of it have been found near Fairfield.

Sonoma County: It is found at Lytton Springs and near Cloverdale and Cazadero. It occurs in the hills near Camp Meeker; 12 miles east of Stewarts Point; small deposits near The Geysers, and on the Madeira property, 8 miles north of Guerneville.

Stanislaus County: Several deposits of chromite have been worked in Arroyo del Puerto Canyon and its branches.

Tehama County: Large deposits of chromite occur at the Lowry mine and the Kleinsorge mine on the North Fork of Elder Creek about 28 miles west of Red Bluff. A large deposit of it occurs 10 miles east of Paskenta, on Toms Creek.

Trinity County: It is found in the sands at Trinity Center; in masses at Island Mountain; reported from Carrville and near Weaverville; a small deposit occurs 10 miles south of Wildwood.

Tulare County: It occurs near Three Rivers on the Nicola property.

Tuolumne County: Masses of chromite have been found 1½ miles west of Chinese Camp.

Yuba County: It is found in the black sands at Camptonville, on the Yuba River, and on Indian Hill.

CHRYSOBERYL

Oxide of beryllium and aluminum, $BeAl_2O_4$.

Orthorhombic. Usually twinned crystals. Striated faces. Cleavage (011) distinct. Brittle. Vitreous luster. Color grass-green, yellowish-green, greenish-brown. Streak uncolored. H. = 8½. G. = 3.5 — 3.84.

Infusible and insoluble. Fine powder, when intensely heated on charcoal, moistened with cobalt nitrate and re-heated, assumes a sky-blue color.

Butte County: Chrysoberyl is reported to have been found near Stanwood and at Big Bar.

HAUSMANNITE

Manganese oxide, Mn_3O_4.

Tetragonal. Small pyramidal crystals, granular massive. Cleavage (011). Submetallic luster. Color brownish-black. Streak chestnut-brown. H. = 5 — 5½. G. = 4.72 — 4.85.

Infusible. Dissolves in hydrochloric acid, yielding chlorine gas. Borax bead is amethystine or wine-colored. Fused on platinum with sodium carbonate, gives deep blue-green fusion.

Manganese oxides are abundant in the State, and hausmannite may occur in many localities and remain unidentified.

Plumas County: Specimens of hausmannite have come from Meadow Valley, Miser and Fairchild (20).

San Luis Obispo County: Hausmannite has been found at the Staneuch ranch manganese deposit in the Prefumo Canyon district.

Santa Clara County: Hausmannite was abundant as crystals, with the forms (001), (113), (111), and (221), in the manganese ore boulder which was found near Alum Rock Park, 5 miles east of San Jose, Rogers (19a).

MINIUM—Read Lead

Lead oxide, Pb_3O_4.

Powder. Dull luster. Color bright-red mixed with yellow. Streak orange-yellow. H. = 2 — 3. G. = 4.6.

Gives a yellow coating of lead oxide on charcoal and is reduced by sodium carbonate to metallic lead.

The red oxide of lead is rarely found native. It is an oxidation product of galena and other lead minerals, occurring as a powder.

Kern County: Minium has been found near Fort Tejon.

Los Angeles County: Minium occurs with barite, galena, and fluorite in the Felix Fluorite mine near Azusa.

CREDNERITE

Oxide of copper and manganese, $CuMn_2O_4$.

Monoclinic? Foliated masses. Cleavage perfect basal. Metallic luster. Color iron-black to steel-gray. Streak brownish-black. H. = 4½. G. = 4.95 — 5.1.

Gives the manganese reactions like hausmannite. and in addition, a blue copper chloride flame when dipped in hydrochloric acid and heated in bunsen flame.

Napa County: Crednerite occurs massive near Calistoga.

BRAUNITE

$3Mn_2O_3.MnSiO_3$.

Tetragonal. Small pyramids and massive. Cleavage (111) perfect. Brittle. Submetallic luster. Color and streak brownish-black. H. = 6 — 6½. G. = 4.75.

B. B. infusible. Soluble in hydrochloric acid and leaves a residue of silica. Gives all the reactions for manganese similar to hausmannite.

Siliceous manganese ores are very common in California, and it is probable that braunite exists in many localities.

Plumas County: Specimens of braunite have come from Meadow Valley.

CASSITERITE—*Tin Stone*

Tin dioxide, SnO_2.

Tetragonal. Crystals low pyramidal; twins common. Massive, granular; in rolled grains. Brittle. Adamantine luster. Color brown, black; sometimes red, gray, white, yellow. Streak white, grayish, brownish. H. = 6 — 7. G. = 6.8 — 7.1.

Infusible and insoluble. With sodium carbonate on charcoal can be reduced to globules of metallic tin. These globules, intensely heated with cobalt nitrate, will give a bluish-green coating.

Stream-tin is cassiterite, or tin ore, in the state of sand, as it occurs in gravels or stream beds.

Placer County: Stream-tin has been found near Michigan Bluff.

Plumas County: Stream-tin was found in the bed of the Middle Fork of Feather River, 3 miles above Big Bar, Hanks (84).

Riverside County: Cassiterite occurs with tourmaline in the Temescal tin mine near Corona. An analysis of an exceptionally pure specimen of the ore was made by Genth, Fairbanks (97).

SiO_2	WO_3	SnO_2	CuO	$Al_2O_3Fe_2O_3MnOCaO$
9.82	0.22	76.15	0.27	13.54

San Diego County: At Mesa Grande small crystals of cassiterite were associated with gem tourmaline, beryl and stibiotantalite, Penfield and Ford (06). Cassiterite has been reported from the placer gravels on the eastern slope of Laguna Mountain; also from Pine Valley and from the south end of Viejas Mountain east of Alpine. It is said to occur in the Defiance Copper district and on Aguanga Mountain. Crystals associated with topaz occur at the Little Three mine, Ramona. Cassiterite occurs in a pegmatite dike about 10 miles east of Oak Grove in the Chihuahua Valley, 2 miles south of the Riverside San Diego county line, with quartz, feldspar, lepidolite, blue tourmaline, columbite, and albite, Schaller (16a).

Siskiyou County: Stream-tin is found in the gravels at Sawyers Bar and on Hungary Creek, a tributary of the Klamath River.

Trinity County: Stream-tin occurs near Weaverville, Hanks (84).

RUTILE

Titanium dioxide, TiO_2.

Tetragonal. Long prisms, vertically striated, and grains; crystals often twinned. Cleavage (100) and (110) distinct. Brittle. Adamantine to metallic luster. Color reddish-brown to brownish-black. Streak pale-brown. H. = 6 — 6½. G. = 4.18 — 4.25.

Infusible. With phosphorous salt yields a delicate violet bead. Insoluble in acids.

Rutile, as a rock constituent in microscopic crystals, is common in many of the metamorphic rocks of the State.

Amador County: Needles of rutile in quartz, forming sagenite, have been reported to occur at Tyler's ranch, near Oleta.

Butte County: Rutile was a constituent of the gold washings at Cherokee, Silliman (73).

Contra Costa County: Irregular patches of brown rutile occur with sphene in glaucophane schist near the south end of the Berkeley Country Club.

Fresno County: Brownish-red rutile crystals occur with ilmenite near Friant. Striated prismatic crystals of rutile have been found in glaucophane schist near Panoche.

Humboldt County: Rutile was first noticed in the State in the granite at Eureka.

Inyo County: Rutile occurs in quartz mica schist on the west side of the Panamint Range near Ballarat, Murphy (32).

Marin County: Prismatic crystals of rutile have been found in a boulder of glaucophane schist on the beach of the Tiburon Peninsula about 150 yards north of California Point.

Mendocino County: Long prismatic crystals of rutile embedded in chlorite occur in glaucophane schist in a highway cut about 3½ miles north of Longvale on the new Covelo road.

Mono County: Minute specks of rutile occur in andalusite at the mine of Champion Sillimanite, Incorporated, on the western slope of the White Mountains, 7 miles east of Mocalno, and crystals of rutile up to an inch in length are found on the Moreau Claim about a mile from this deposit, Kerr (32). It occurs in small reddish-brown crystals in white quartzite with bands of blue lazulite near Mono Lake.

Placer County: Rutile has been reported at Michigan Bluff.

San Diego County: Rutile is one of the constituents of the dumortierite schist at Dehesa, Schaller (05).

Santa Clara County: The schists of Calaveras Valley carry rutile Murgoci (06). Rough crystals of rutile occur with actinolite, sphene,

and garnet in glaucophane schist in Coyote Canyon about 6 miles east of Morgan Hill.

ANATASE—Octahedrite

Titanium dioxide, TiO_2.

Tetragonal. Small pyramidal crystals. Cleavage perfect basal and pyramidal. Brittle. Adamantine to metallic luster. Color brown. Streak uncolored. H. = 5½ — 6. G. = 3.82 — 3.95.

Same reactions as rutile.

This form of titanium oxide is rarer than rutile, and is found only in minute crystals.

El Dorado County: Minute crystals of anatase with brookite were found implanted on quartz crystals near Placerville, Kunz (92), (01).

BROOKITE

Titanium dioxide, TiO_2.

Orthorhombic. Crystals tabular or pyramidal. Brittle. Adamantine luster. Color reddish-brown to black. Streak uncolored to grayish. H = 5½ — 6. G. = 3.87 — 4.01.

Reactions the same as for rutile. Distinguished by form.

El Dorado County: Brookite has been found in tabular reddish-brown crystals, with anatase on quartz crystals at Placerville. Forms by Penfield: (100), (001), (110), (210), (102), (104), (021), (121), (122), (134), and (234), Kunz (92), (01).

HYDROUS OXIDES

PYROLUSITE

Manganese dioxide, $MnO_2.nH_2O$.

Usually columnar, often divergent; also granular massive. Luster metallic. Color and streak black. H. = 2 — 2½. G. = 4.73 — 4.86.

Soluble in hydrochloric acid with evolution of chlorine. Some varieties yield water in the closed tube.

Pyrolusite is a common mineral generally associated with other ores of manganese. It is usually found as fibrous seams and coatings in masses of psilomelane. Common as dendritic coatings.

Alameda County: Pyrolusite occurs with psilomelane in the Corral Hollow and Arroyo Mocho manganese deposits.

Amador County: It is found in the Seaton mine, and on volcanic ash at Volcano. Pyrolusite occurs with psilomelane 1½ miles south of Volcano.

Calaveras County: It occurred at Wild Rose Flat near Murphy. Good specimens of pyrolusite have come from San Andreas. It is found 3 miles northeast of Milton. It occurs with psilomelane near Angels Camp.

Colusa County: Pyrolusite found with cinnabar at Stonyford. It occurs at the Manzanita mine.

Contra Costa County: It occurs with psilomelane on Red Rock in San Francisco Bay.

El Dorado County: It occurs in dendritic coatings near Placerville, and fibrous at Greenwood. Masses of it occur at Greenwood, and at Cool.

Humboldt County: Pyrolusite occurs with psilomelane at Alder Point; also on the Porter ranch, Fort Baker.

Kern County: Pyrolusite with some psilomelane occurs 5 miles west of Atolia.

Lake County: It occurs with psilomelane at the Phillips mine near Laurel Dell.

Los Angeles County: It occurs with psilomelane in small amounts at Banning.

Madera County: It occurs with limonite 14 miles from Fresno Flat; also near Coarse Gold with psilomelane, manganite, rhodochrosite, and rhodonite.

Marin County: Small amounts of pyrolusite were found in the rock at Sausalito.

Mariposa County: It occurs with psilomelane at Jasper Point. Small masses of it occur in Hunters Valley.

Mendocino County: It is found at Red Mountain. It occurred with psilomelane at the Independence Manganese mine, Potter Valley; near Covelo; 4 miles west of Hopland with psilomelane; in Redwood Valley; near Willits; at the Long mine near Woodman Station; in chert at Westport; at the Cleveland mine, Ukiah.

Mono County: Pyrolusite and psilomelane occur in the Bodie mines.

Napa County: Pyrolusite occurred as radiate concentric masses with cinnabar at the old Redington and Manhattan mines, Knoxville. Small amounts of it occur with psilomelane on Mount St. Helena, and 3 miles west of Oakville.

Nevada County: It was found in the Grass Valley district, Lindgren (96); also at Sweetland, and as dendrite on the rocks of Sugar Loaf Hill.

Placer County: Pyrolusite occurs 12 miles from Auburn on Wolf Creek Road.

Plumas County: It is common in the Diadem lode, Meadow Valley district.

Riverside County: It occurs near Elsinore.

San Bernardino County: Pyrolusite occurs in the Calico and Barstow districts. It occurred with psilomelane in the Emma and Owls Hole mines, in the Owl Mountains.

San Francisco County: It has been found in small amounts with psilomelane at Hunters Point.

San Joaquin County: It is found in the manganese deposits of the Diablo Range.

San Luis Obispo County: Pyrolusite is found with psilomelane in the manganese deposits on the Staneuch ranch, 8 miles west of San Luis Obispo.

San Mateo County: It occurs at Baden.

Santa Clara County: Pyrolusite was found at the Washington mine, and in the mines of the Diablo Range.

Shasta County: It is found in small amounts about 16 miles northwest of Redding.

Sierra County: It is common as dendrites at Alleghany.

Siskiyou County: It occurs with rhodonite at Sawyers Bar.

Sonoma County: It occurred at the Shaw mine.

Stanislaus County: Soft botryoidal pyrolusite and psilomelane form the ore of the Seagrave mine. Pyrolusite occurs with rhodochrosite at the Buckeye mine on Hospital Creek.

Tehama County: Pyrolusite and psilomelane occur on the Luce prospect.

Tuolumne County: It is common with psilomelane at Knapp's ranch, near Columbia.

DIASPORE GROUP

DIASPORE

Hydrous aluminum oxide, $Al_2O_3.H_2O$.

Orthorhombic. Prismatic crystals or foliated masses. Good cleavage. Very brittle. Brilliant luster. Colorless, white, gray, green, brown. H. = $6\frac{1}{2}$ — 7. G. = 3.3 — 3.5.

Infusible and insoluble.

Mono County: Diaspore occurs in compact masses with andalusite at the mine of Champion Sillimanite, Incorporated, on the western slope of the White Mountains, 7 miles east of Mocalno, Kerr (32).

GOETHITE

Hydrous oxide of iron, $Fe_2O_3.H_2O$.

Orthorhombic. Slender prisms, vertically striated. Also fibrous; massive. Cleavage perfect brachypinacoidal. Brittle. Adamantine to submetallic luster. Color yellowish, reddish, and blackish-brown. Streak yellowish-brown. H. = 5 — 5½. G. = 4.28.

Distinguished from the more common limonite by its crystalline-fibrous and columnar structure and cleavage. In the closed tube it gives off water and is converted into red iron sesquioxide. Soluble in hydrochloric acid.

Goethite is usually found as slender prismatic crystals in masses of limonite or hematite, and resembles limonite so closely that it is often classed as such.

Inyo County: Goethite has been found with chrysocolla and limonite at the St. Ignacio mine.

Mariposa County: It occurs at Burns Creek in masses of limonite.

Riverside County: Goethite is associated with the other iron minerals of the Eagle Mountains, Harder (12).

San Bernardino County: It occurs with limonite at the magnetite-hematite deposit near Dale.

MANGANITE

Hydrous oxide of manganese, $Mn_2O_3.H_2O$.

Orthorhombic. Crystals long prisms. Structure usually columnar. Perfect brachypinacoidal cleavage. Brittle. Submetallic luster. Color iron-black. Streak dark reddish-brown. H. = 4. G. = 4.2 — 4.4.

Yields the manganese reactions as given under hausmannite, and a slight amount of water in a closed tube.

There are numerous small deposits of manganese ore in the State, and much of it is manganite mixed with a more or less siliceous psilomelane. The deposits generally consist of black porous ore in masses and lenses in red and brown jasper, Harder (10).

Alameda County: Much of the manganese produced in this State has come from manganite in the deposits of the Livermore-Tesla district, along Arroyo Mocho Creek, southeast of Livermore.

Calaveras County: Manganite with psilomelane occurs 2 miles northeast of San Andreas in mica schist.

Colusa County: Small deposits of manganite occur on the east flank of St. John Mountain, near Little Stony.

Contra Costa County: The deposits on Red Rock in San Francisco Bay contain some manganite with the psilomelane.

Kern County: Manganite occurs with psilomelane in the Rand mining district, near Randsburg.

Marin County: Some manganite is found in the red rock near Sausalito.

Mendocino County: It occurs at the Cave mine, 10 miles northeast of Ukiah.

Placer County: Small pieces of manganite have been found near Colfax.

Plumas County: Considerable manganese ore occurs in the Meadow Valley and other districts, and manganite is probably common.

Riverside County: Manganite and psilomelane occur in a network of veins in schist 6 miles northeast of Elsinore, in the Maria Mountains.

San Joaquin County: Some small deposits of manganite occur in jasper in the Diablo Range. The Ladd or Corral Hollow mine southeast of Livermore is the best known and earliest worked manganese mine in the State.

San Luis Obispo County: Small deposits of it occur 5 miles west of San Luis Obispo.

Santa Clara County: It is found in the Black Wonder and other mines of the Diablo Range.

Shasta County: Manganite is reported to occur at the Murray mine, near Redding, in small crystals filling fractures in quartz.

Sonoma County: It is found at the Shaw mine, 8 miles northwest of Cloverdale.

Tuolumne County: It occurs with rhodonite 2 miles north of Sonora.

LIMONITE—Brown Hematite

Hydrous oxide of iron, $Fe_2O_3.nH_2O$.

Not crystallized. Massive. Compact, stalactitic, botryoidal, columnar, fibrous, earthy. Submetallic to dull luster. Color ocher-yellow, brown to black. Streak yellowish-brown. $H. = 5 - 5\frac{1}{2}$. $G. = 3.6 - 4$.

Becomes magnetic on heating. Soluble in hydrochloric acid, and brown ferric hydrate is precipitated by ammonia. Yields water in a closed tube.

Limonite as the common alteration product of pyrite and of most minerals containing iron, is prevalent in most mineral districts and forms the 'gossan' or brown capping of ore deposits. Cubes of limonite as pseudomorphs after pyrite are common in mining regions. As an ore of iron it is not so valuable as hematite or magnetite, but a number of deposits have been utilized for paint pigments. It is present in every county in some form, but only a few of its occurrences are cited.

Alameda County: Earthy limonite mixed with hematite is common as a 'gossan' capping of the pyrite deposit at Leona Heights.

Amador County: It is found in concretions and earthy masses at Pine Grove; with hematite and magnetite at Volcano.

Butte County: Thick masses of limonite occurred at the Monarch mine; cubes at Red Hill and at Magalia.

Calaveras County: It forms the capping of a hill about 1½ miles north of Murphy. The Detert limonite deposit near Valley Springs was formerly worked, Harder (10b). Massive and earthy limonite occurs at the Eureka mine, near Valley Springs. Yellow and red ocherous limonite occurs at Campo Seco. A deposit occurs on Bonanza Creek, 7 miles southeast of Mokelumne Hill. Massive limonite has come from the Dieffenbach ranch, 25 miles northeast of Valley Spring.

Colusa County: Yellow ocherous limonite occurs in a large outcrop 4½ miles west of Stonyford. Limonite suitable for mineral paint occurs 4 miles south of Lodoga.

El Dorado County: Massive limonite occurs near Diamond Springs.

Inyo County: Pseudomorphs after long prisms of stibnite have been found at the Cerro Gordo mine.

Lake County: Yellow and brown limonite suitable for paint occur 2 miles north of Hough Springs. Massive specimens of limonite have come from the hills near Glenbrook.

Mariposa County: Fine large cubes of limonite have come from the Chowchilla Valley. It occurs as 'gossan' at Burns Creek, W. P. Blake (58).

Napa County: A deposit of limonite occurs 1½ miles east of Calistoga.

Placer County: Massive limonite occurs at the Clipper Gap mine, and at Gold Run.

Plumas County: It occurs massive in Lights Canyon and at Nelson Point. Red and yellow ocherous limonite occurs near Quincy.

Riverside County: Yellow and brown limonite is common in the pisolitic cavities formed by the brucite, at Crestmore, Eakle (17). Massive limonite with some goethite occurs on the Eagle Mountains.

Sacramento County: Yellow ocherous limonite occurs at Michigan Bar.

San Luis Obispo County: Brown banded masses of limonite occurring with hematite interbedded with Franciscan shales and sandstones have come from the Prefumo ranch in the Los Osos Mountains, Harder (10b). Dark-brown massive limonite is found at the Harrington mine, 4 miles southwest of San Luis Obispo.

Shasta County: It is common as cappings of the pyrite deposits of the county. Pseudomorphs after hedenbergite have been found at Ydalpom. Highly iridescent specimens have come from Copper City. Excellent bronze-colored stalactites occurred at the Lost Confidence mine, Iron Mountain.

Sonoma County: Yellow ocherous limonite occurs at the Occidental mine and on the Lancaster ranch, east of Fisk's Mills.

Stanislaus County: A deposit of yellow ocherous limonite used for paint occurs at Knights Ferry on the Stanislaus River.

Tulare County: It is common in the Mineral King district.

Tuolumne County: Pure earthy limonite occurs at the Volunteer mine, on Five Mile Creek, 7 miles east of Columbia.

Yolo County: It is found in the sands at Capay.

BAUXITE

Hydrous oxide of aluminum, $Al_2O_3.nH_2O$.

Massive, earthy, pisolitic. Color white, yellow, red, or brown. H. = 1½. G. = 2.55.

Infusible and insoluble. Moistened by a few drops of cobalt nitrate and intensely heated, the powder assumes a sky-blue color. Fused with sodium carbonate and the mass dissolved in hydrochloric acid, leaves no silica residue. Ammonia precipitates flocculent aluminum hydroxide from the solution. The absence of silica differentiates it from clay.

Bauxite closely resembles clay and is only distinguished at sight from clay by its characteristic pea-shaped, or pisolitic structure.

Riverside County: Red and gray pisolitic bauxite occurs in Sec. 26, T. 4 S., R. 6 W., S. B. M., Richard (22).

BRUCITE

Magnesium hydroxide, $Mg(OH)_2$.

Hexagonal-rhombohedral. Crystals usually broad tabular. Foliated plates and fibrous masses. Cleavage perfect basal. Sectile. Pearly luster. Color white, gray, pink, blue, green. H. = 2½. G. = 2.38 — 2.4.

B. B. infusible. Yields a small amount of water in a closed tube. Easily soluble in dilute hydrochloric acid, and magnesia is precipitated by sodium phosphate. Gives a pink color characteristic of magnesia when intensely heated with cobalt nitrate.

Brucite occurs as thin veins in serpentine, but very little has been observed in the State as an alteration of serpentine. It also occurs as a metamorphic mineral in crystalline magnesian limestone.

Riverside County: Brucite is abundant in small globular masses in the white crystalline limestone at Crestmore, formed probably as a hydration product of periclase. Analysis by Eakle (17):

MgO	Fe_2O_3	H_2O
67.48	0.55	31.73 = 99.76%

San Francisco County: Brucite was found with xonotlite in serpentine in cuts made by the Western Pacific Railroad on Army Street, San Francisco.

PYROCHROITE

Manganese hydroxide, $Mn(OH)_2$.

Hexagonal-rhombohedral. In hexagonal plates. Perfect basal cleavage. Pearly luster. Color white, but alters to brown and black. H. = $2\frac{1}{2}$. G. = 3.26.

B. B. infusible. Heated in a closed tube, it becomes green, then black, and yields water. Gives green bead with sodium carbonate.

Santa Clara County: Pyrochroite was a prominent constituent of a boulder of manganese ore near Alum Rock Park, 5 miles east of San Jose, Rogers (19a).

PSILOMELANE

A manganese oxide, usually impure.

Massive, botryoidal, stalactitic. Prominent conchoidal fracture. Luster submetallic, dull. Color black. Streak brownish-black. H. = 5 —7. G. = 3.3 — 4.7.

Yields the manganese reactions as given under hausmannite, as well as water in a closed tube, and tests for impurities, especially barium.

Psilomelane is the chief ore of manganese in the State. It is usually associated with manganite or pyrolusite, and often with limonite. The characteristic occurrence of the more important deposits is in seams and irregular masses in jasper.

Wad is a soft, impure variety.

Asbolite is a wad containing cobalt.

A detailed report on the manganese deposits of California has been issued by the State Division of Mines as Bulletin No. 76.

Alameda County: Psilomelane is the chief mineral in the manganese deposits near Corral Hollow and the Arroyo Mocho.

Amador County: Deposits of psilomelane mixed with pyrolusite occur $1\frac{1}{2}$ miles south of Volcano; 4 miles east of Pine Grove; and about a half mile southeast of Defender.

Butte County: Psilomelane occurs in several localities near Clipper Mills.

Calaveras County: Deposits of psilomelane occur 2 miles northeast of San Andreas and 6 miles southeast of Valley Springs. Psilomelane with pyrolusite occurs 3 miles northeast of Milton.

Colusa County: Psilomelane occurs in small amounts on the eastern slope of St. Johns Mountain, west of Stonyford.

Contra Costa County: Psilomelane was formerly mined on Red Rock in San Francisco Bay.

Fresno County: Psilomelane occurs on Pine Flat, near Piedra.

Glenn County: It occurred with pyrolusite at the Black Diamond and Rattlesnake mines, about 30 miles southwest of Fruto. Some siliceous psilomelane is reported from Millsaps.

Humboldt County: It occurs with pyrolusite in good massive ore on the Porter ranch, Fort Baker.

Imperial County: Psilomelane deposits have been reported in the Chocolate Mountains.

Inyo County: It is found at the southeast end of the Panamint Range, 25 miles south of Bennett's wells on the Death Valley Slope.

Kern County: Wad has been found as a pseudomorph after calcite at the Echo mine near Mojave, Rogers (10a).

Lake County: Small amounts of good manganese ore come from Glenbrook. Psilomelane occurs on the Phillips ranch about 1½ miles south of Laurel Dell, and on Dry Creek about 3 miles west of Middletown. A large deposit of it occurs about 10 milies north of Upper Lake on the southwestern slope of the Horse Mountains. The manganese ore of the Smythe manganese prospect is mainly psilomelane with some pyrolusite.

Los Angeles County: Asbolite occurred in the O K mine, San Gabriel Canyon. Deposits of siliceous psilomelane occur about 5 miles west of Palmdale.

Marin County: Small streaks and pockets of psilomelane occur near Sausalito and Fort Baker. Psilomelane is found in masses on the Mailliard ranch, about 8 miles northwest of San Rafael.

Mariposa County: Small masses of psilomelane occur in Hunters Valley.

Mendocino County: Large deposits of psilomelane occur in Potter Valley. It is reported to have been found in large amounts on Pieta Creek, near Pieta. Deposits of psilomelane occur at the Cleveland mine, 3 miles east of Calpella, and at the Independent mine, 14 miles east of Willits. It occurs in the hills east of the Middle Fork of Eel River. Psilomelane with rhodochrosite occurs on Mount Sanhedrin. Psilomelane in jasper is found at the Thomas and Wild Devil mines, about 6 miles northeast of Redwood Station.

Merced County: Manganese ore deposits occur about 26 miles east of Tres Pinos.

Monterey County: It occurs about 3 miles north of the mouth of San Carpojaro Creek and 1 mile inland; also in the Chalone district, near Soledad.

Napa County: A deposit of psilomelane occurs 5 miles west of Oakville, and another 6 miles northeast of St. Helena. Small amounts of manganese minerals occur on Mount St. Helena; on Moore Creek, and 3 miles west of Oakville.

Nevada County: Wad occurs near the North Banner mine. Psilomelane occurs near the west bank of the Bear River, 7 miles from Colfax. A large body of psilomelane occurs in the Limekiln district.

Placer County: Masses of it are found at Michigan Bluff. Deposits of psilomelane occur about nine miles north of Colfax, near Yankee Jim.

Plumas County: Large masses of it occur on Mumford Hill. Psilomelane, manganite, and rhodonite occur in the Diadem and Penrose lodes, near Edmanton, in the Meadow Valley district. Deposits of it occur near Crescent Mills.

Riverside County: Deposits of psilomelane occur in the McCoy Mountains about 12 miles northwest of Mineral Station. Psilomelane occurs about 7 miles southwest of Perris interbedded with jasper. Black massive psilomelane occurs in the Palen Mountains, about 22 miles northwest of Mineral. It occurs about 6 miles northeast of Elsinore with rhodonite. It is found at the base of the Santa Maria Mountains, and about 8 miles northwest of Palo Verde. Fine specimens have come from Winchester.

San Benito County: Stringers and coatings of psilomelane occur with benitoite near the headwaters of the San Benito River, Louderback (09). It occurs in cherts on the Fries and Lewis ranches about 18 miles east of Tres Pinos.

San Bernardino County: Psilomelane occurs on the northern slope of the Avawatz Mountains, and at the Owls Hole mine, Owl Mountain. It is found with pyrolusite in the Lavic Mountains, 5 miles northwest of Ludlow. Good specimens have come from Wagner, Mojave Desert. Massive asbolite has been found with gypsum in clay in the Borate district, 7 miles east of Yermo.

San Diego County: Fine specimens have come from Campo.

San Joaquin County: Psilomelane is found in the manganese ore deposits of the Diablo Range, notably at the Ladd mine in Corral Hollow.

San Luis Obispo County: Psilomelane occurs on the Staneuch ranch, 8 miles west of San Luis Obispo.

Santa Clara County: The outer crust of the manganese ore boulder near Alum Rock Park, 5 miles east of San Jose, was psilomelane, Rogers (19a).

Shasta County: A deposit of psilomelane occurs on the Pit River, 1 mile south of Heroult. It occurs with jasper in Arbuckle Mountain.

Siskiyou County: It occurs in small amounts with pyrolusite near Fort Jones. A deposit has been noted on the road between Black Bear P. O., and the King Solomon mine.

Sonoma County: Deposits of psilomelane occur near Freestone. Psilomelane occurs with rhodochrosite at the Aho property near Cazadero. A deposit of high-grade psilomelane occurs on the Shaw ranch, 7 miles northwest of Cloverdale.

Stanislaus County: It occurs on Arroyo del Puerto, west of Patterson, and in the manganese ore deposits of the Diablo Range, notably at the Buckeye mine, west of Vernalis.

Tehama County: It occurs with jasper on Beauty View Butte, 10 miles west of Paskenta.

Tulare County: Melhase (34) has reported the occurrence of asbolite from the King C. Gillette farm, near Lindsay.

Tuolumne County: It is found massive with pyrolusite near Columbia.

CARBONATES

Anhydrous		*Hydrous*
Calcite Group	*Aragonite Group*	Malachite
Calcite	Aragonite	Azurite
Magnesite	Strontianite	Aurichalcite
Siderite	Witherite	Hydrozincite
Rhodochrosite	Cerusite	Dawsonite
Smithsonite		Thermonatrite
Dolomite	Bismutosphärite	Nesquehonite
Ankerite	Phosgenite	Natron
	Northupite	Pirssonite
	Tychite	Gay-Lussite
		Trona
		Hydromagnesite
		Zaratite
		Bismutite

ANHYDROUS CARBONATES

CALCITE GROUP

CALCITE

Calcium carbonate, $CaCO_3$.

Hexagonal-rhombohedral; scalenohedral. Crystals common, rhombohedrons and scalenohedrons. Also massive, fibrous, granular, stalactitic, chalky. Cleavage perfect rhombohedral. Vitreous luster. Colorless, white, gray, red, green, blue, yellow, brown, black. Streak white or grayish. H. = 3. G. = 2.71.

B. B. infusible. The carbonates are all characterized by their effervescence with hydrochloric or nitric acids. Calcite effervesces freely in cold dilute acid and gives a flame test that is bright red at first, fading into a yellow red. The calcium can be precipitated by ammonium oxalate as a white granular calcium oxalate.

Calcite is exceedingly common and occurs in many varieties based on color and structure. Some of these varietal names are: *iceland spar, marble, onyx marble, travertine, lithographic stone* and common *limestone.* Extensive beds of limestone are common in the State, and are quarried for the manufacture of cement. Fine quality marble is also found.

Manganocalcite is a variety containing manganese. It weathers black.

Alameda County: Crystals are common in the chalcedony geodes on the Berkeley Hills. A fine grade of lithographic stone occurs on the Crocker-Winship properties, south of Danville. Crystals of calcite and massive limestone occur near Sunol.

Alpine County: Fine groups of calcite rhombohedrons have come from the Pennsylvania mine.

Amador County: Light-gray and bluish marble occurs $2\frac{1}{2}$ miles east of Plymouth in Dry Creek Canyon, and near Pine Grove.

Butte County: A black mottled marble is found at Pentz; on the West Branch of Feather River, a few miles west of Yankee Hill; white and bluish crystallized limestone occurs at the Big Bend of the North Fork of Feather River, near Intake Station.

Calaveras County: Crystals occur near Natural Bridge. Fine stalactites occur in Mercers Cave, $1\frac{1}{4}$ miles northwest of Murphy. Good marble occurs near Murphy and near San Andreas. White and variegated marble occurs about $1\frac{1}{4}$ miles east of San Andreas; also about 4 miles southeast of Valley Springs.

El Dorado County: Fine stalactites occur at the Alabaster Cave. Good crystals were found at the Cosumnes copper mine. Large cleavage rhombohedrons occur in the Starlight mine, 3 miles south of Mud Springs.

Fresno County: Good white, blue, black, and variegated marble occurs on the south side of Big Creek, 5 miles below Cascada. Veins of fluorescent calcite with cinnabar in serpentine occur along Avenal Creek, Melhase (35).

Glenn County: Banded marble occurs on the Nye ranch and on the east side of Stony Creek.

Imperial County: A large deposit of crystalline limestone or marble occurs on the south side of Coyote Mountain. Analysis:

$CaCO_3$	$MgCO_3$	SiO_2	$Al_2O_3Fe_2O_3$	$CaSO_4$
96.6	1.7	tr.	0.9	0.5 = 99.7%

Good variegated marble occurs at the Fowler quarry, Coyote Mountain.

Inyo County: Thick deposits of variegated dolomitic marble occur at the foot of the Inyo Mountains, between Keeler and Lone Pine. Fine crystal specimens and stalactites have been found at the Cerro Gordo and Union mines. Gray, greenish, and yellow marble occurs at the Lindsay quarries, Walker River; fine crystals at the Lane mine.

Kern County: A large deposit of crystalline limestone occurs 3 miles south of Tehachapi, near Neenach. Blue rhombohedrons occur in Grizzly Canyon, 3 miles southwest of Tehachapi.

Lake County: A small body of crystalline limestone occurs near Hullville.

Los Angeles County: Calcite crystals occur with the colemanite at Lang with the forms: $(10\bar{1}0)$, $(10\bar{1}1)$, $(01\bar{1}2)$, $(09\bar{9}5)$, $(02\bar{2}1)$, and (0001), Eakle (11). White marble occurs in Antelope Valley; also in

Pacoima Canyon, near San Fernando. Pink rhombohedrons were found on Santa Catalina Island.

Marin County: Low thin-edged rhombohedrons of manganocalcite occur in a trachyte on the Burdell ranch. They turn black when heated, and also blacken by weathering.

Mariposa County: Good crystals have come from the mines near Mariposa. A large deposit of white marble containing dark streaks occurs on the South Fork of Merced River. Calcite crystals occur with quartz and arsenopyrite at the Smith mine, Bear Valley.

Merced County: A strontium-bearing calcite is reported to occur at Delhi.

Modoc County: Small stalactites occur on the South Fork of Pit River. Iceland spar of excellent quality has been found in the Warner Range near Cedarville, Hughes (31).

Mono County: A large deposit of travertine occurs near Bridgeport. Good crystals have come from the Bodie district. A mass of white marble occurs in a canyon southeast of Topaz. Layers of interlaced calcite crystals found about Mono Lake have been called *thinolite* by E. S. Dana (84). Iceland spar has been found in limestone in the upper Convict basin near Mammoth Lakes, Mayo (34).

Monterey County: Large perfect crystals occur near Soledad. A deposit of limestone occurs near Natividad, 9½ miles from Salinas. Sand-calcite crystals have been described from the Cholame Hills, Sec. 14, T. 23 S., R. 13 E., M. D. M., by Rogers and Reed (26).

Napa County: Onyx marble has come from near Knoxville.

Nevada County: Calcite is common in the Grass Valley and Nevada City mines. Fine scalenohedrons have come from the Pittsburg mine. It is found northeast of Nevada City on the banks of the South Fork of Yuba River. Calcite crystals occur with kämmererite at the Red Ledge mine, near Washington.

Orange County: Greenish and white marbles occur in Cool Canyon on the west side of Mount Downey, Santa Ana Range.

Placer County: Calcite is one of the minerals of the Ophir district, Lindgren (94). White marble occurs near Hotaling. A fine black marble with occasional white veinlets occurs near Colfax.

Plumas County: Large divergent masses of calcite occur in the Genessee Valley. Marble occurs on the sides of the Middle Fork of Feather River.

Riverside County: Blue calcite occurs at Crestmore, Eakle (17).

San Benito County: Calcite is found in the rocks adjoining the benitoite veins near the headwaters of the San Benito River, Louderback (09).

San Bernardino County: A large deposit of beautiful variegated marble occurs at the Gem marble quarries in the Silver Mountain district about 5 miles south of Oro Grande. Gray limestone is quarried for cement on Slover Mountain, near Colton. Large calcite cleavage masses with black carbonaceous matter arranged zonally occur 6 miles northwest of Ludlow. A large deposit of white, pink, and blue calcite occurs near Baxter. Iceland spar occurs in the Cave Canyon district, near Yermo.

San Diego County: White and gray banded marble occurs on Los Peñasquitas Creek. Dark-gray marble occurs near Jacumba; a large bed of white speckled marble occurs $4\frac{1}{2}$ miles northeast of Dos Cabezas Springs.

San Francisco County: Schaller (11) has described calcite crystals from Fort Point showing the forms $(10\bar{1}1)$, $(01\bar{1}2)$, $(21\bar{3}1)$, $(53\bar{8}2)$, $(23\bar{5}8)$, $(4.16.\overline{20}.3)$, and $(1.6.\bar{7}.13)$.

San Luis Obispo County: Beautiful onyx marble with moss-like inclusions of greenish chlorite which impart a landscape effect to translucent thin slabs, occurs at the Kessler deposit, about 17 miles northeast of Arroyo Grande.

San Mateo County: Crystals have come from near San Pedro. Calcite occurs as crystalline veins in limestone at Montara.

Santa Clara County: Yellow, white, and brown marble occurs 5 miles southeast of New Almaden.

Santa Cruz County: In the area between Santa Cruz, Felton, and Davenport there are numerous quarries in coarsely crystalline limestone, Eckel (33). Calcite crystals showing the forms $(01\bar{1}2)$, $(10\bar{1}1)$, and $(40\bar{4}1)$ have been found in the Vicente Creek tunnel near Davenport.

Shasta County: Large stalactites and tubular aggregates of calcite occur in Potters Cave near Baird, Eakle (07).

Siskiyou County: Large deposits of white and variegated marble occur on Marble Mountain.

Solano County: Onyx marble and massive limestone occur near Tolenas. A brown banded onyx marble occurred near Suisun.

Sonoma County: Calcite occurs in geodes near Petaluma. There is a deposit of limestone on the Black ranch on Little Sulphur Creek, 6 miles north of Geyserville which has been mined commercially. W. W. Bradley (16).

Trinity County: Calcite occurs with garnet and epidote at Red Mountain.

Tulare County: Dark-gray marble occurs on the James ranch, 8 miles southeast of Porterville.

Tuolumne County: White and blue-veined marbles occur in an extensive deposit on the Stanislaus River a few miles north of Columbia. Fine crystals with the forms $(10\bar{1}0)$, $(01\bar{1}1)$, and $(3\bar{1}21)$ were found at the Keltz mine. Large stalactites were found at the Crystal Palace Cave near Columbia. White granular calcite showing bright scarlet triboluminescence has been found near Columbia, Melhase (35).

Yuba County: Marble occurs on the north and south sides of the Yuba River, and on Oregon Creek.

MAGNESITE

Magnesium carbonate, $MgCO_3$.

Hexagonal-rhombohedral; scalenohedral. Crystals are rare. Generally compact massive; sometimes earthy. Cleavage perfect rhombohedral. The compact massive variety shows no cleavage, but shows a flat conchoidal fracture. Brittle. Luster vitreous, sometimes silky. Color snow-white to brown. H. $= 3\frac{1}{2} - 4\frac{1}{2}$. G. $= 3.0 - 3.12$.

Cold dilute hydrochloric acid has little effect on magnesite, but when heated causes it to effervesce freely. The solution, when treated by ammonia, amonium oxalate, and sodium phosphate, will give an important precipitate only when the last reagent is used. Magnesite moistened with cobalt nitrate and intensely heated, will turn pink.

Magnesite is widespread in California because of the great areas of serpentine, of which it is an alteration product. The serpentine is commonly intersected by veins and patches of snow-white to light-buff magnesite. Some of these veins are commercially important. The main deposits lie in the serpentine belts of the Coast Ranges, but deposits also occur in serpentines in the foothills of the Sierra Nevada and elsewhere. The mineral is mostly in cryptocrystalline masses with prominent conchoidal fracture, and the siliceous varieties are very hard. The magnesite deposits of California have been described in Bulletin No. 79 of the State Division of Mines.

Alameda County: Small veins of magnesite occur in the serpentine on Cedar Mountain, about 22 miles southeast of Livermore. Stray boulders have been found on Hoyle's ranch, 11 miles southeast of Livermore.

Calaveras County: Veins of magnesite occur near San Andreas.

Fresno County: A very pure magnesite occurs in veins on Kings River at Piedra, 9 miles east of Sanger. Deposits showing peculiar surface jointage cracks occur in Watt Valley.

Kern County: Some veins of magnesite were found near Walkers Pass, east of Bakersfield. A sedimentary bedded deposit of magne-

site interstratified with clay and clay shales occurs about three-fourths of a mile northeast of Bissell Station, 11 miles east of Mojave, Gale (14d). The magnesite from Bissell was analyzed by Fairchild, Clarke (15).

SiO_2	MgO	CaO	CO_2	$(Al,Fe)_2O_3$
6.03	42.78	1.56	45.78	1.40 = 97.55%
4.75	44.20	tr.	47.32	0.76 = 97.03%

Kings County: Magnesite occurs in the southwest corner of the county, near Parkfield, Bradley (25).

Los Angeles County: A small deposit of magnesite occurs in serpentine on a branch of San Francisquito Canyon.

Mendocino County: Pure white veins of magnesite occur on the Hixon ranch, about 12 miles north of Cloverdale. Analysis by Peters, Hess (08a).

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	CO_2
0.41	0.28	0.12	0.03	47.16	51.88 = 99.88%

A deposit of it also occurs 15 miles northwest of Cloverdale.

Modoc County: Specimens of magnesite have come from near Adin.

Monterey County: Magnesite was found 3 miles east of Parkfield.

Napa County: A large number of veins of magnesite occur in the serpentine of the county. It is prominent at the Bartlett and Stanley mine in Chiles Valley, about 10 miles north of Rutherford. Analyzed by: 1, Bates. 2 and 3, Hanks, Hess (08a).

	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	CO_2	H_2O
1.	2.15	1.22	1.16	5.28	41.01	48.72	--- = 99.54%
2.	1.81	0.08		tr.	46.55	51.25	0.32 = 100.01%
3.	6.68	15.10	---	---	37.23	40.98	--- = 99.99%

Veins of it also occur on the east side of Pope Valley, in Soda Creek Canyon, and in the serpentine of Berryessa Valley. Large veins of it occur at the White Rock mine in Pope Valley.

Nevada County: Narrow veins of magnesite occur in the serpentine at Nevada City.

Placer County: Veins of magnesite occur 1 mile east of Damascus and near Michigan Bluff; also at Gold Run. Deposits of it occur about 5 miles northeast of Iowa Hill, and near Towle. Analysis of the Damascus material by Wells, Gale (14d).

$SiO_2(Al,Fe)_2O_3$	CaO	MgO	CO_2	H_2O
0.2	none	47.3	51.6	0.6 = 99.7%

Riverside County: Veins of magnesite are found in a hill of serpentine about 3½ miles south of Winchester. Analysis by Bates, Hess (08a).

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	CO_2
4.73	0.12	0.08	0.43	44.77	49.40 = 99.53%

San Benito County: Large deposits of magnesite occur on the western slope of Sampson Peak, 3 miles southwest of New Idria. Some of the magnesite at the Sampson mine is coated with dolomite. Analysis by Hicks, Gale (14d).

SiO_2	FeO_3	CaO	MgO	CO_2
0.81	0.52	1.04	46.67	50.60 = 99.64%

San Bernardino County: Magnesite occurs at the Quaker group of claims in the Providence Mountains, 12 miles southeast of Cima; also near Needles. A deposit of bedded magnesite occurs on the south side of Cave Canyon of the Mojave River, 1½ miles southeast of Afton, 3½ miles west of Baxter; Hewett, Callaghan, Moore, Nolan, Ruby, and Schaller (36).

San Francisco County: Small veins of magnesite occur in the serpentine at Fort Point and in the Potrero district in San Francisco.

San Luis Obispo County: Small veins of magnesite occur on the Kiser ranch about 9 miles northwest of Cambria.

Santa Barbara County: Deposits of magnesite occur about 12 miles southeast of Los Olivos, near the base of the San Rafael Mountains.

Santa Clara County: Large veins of magnesite exist in Red Mountain, 32 miles southeast of Livermore. An analysis by Peters, Hess (08a), of pure magnesite from the Alameda claim gave:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	CO_2
0.73	0.14	0.21	0.40	46.61	51.52 = 99.61%

Magnesite from Red Mountain was analyzed by Wells (37). The Western Magnesite Development Company has been an important producer at Red Mountain.

SiO_2	$Al_2O_3Fe_2O_3$	CaO	MgO	CO_2	H_2O
0.03	0.07	0.85	46.70	51.94	0.29 = 99.88%

An analysis by Peters, Hess (08a), of buff-colored siliceous magnesite from the Cochrane ranch, about 3½ miles from Morgan Hill Station, gave:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	CO_2
49.85	3.45	0.18	0.48	21.53	23.96 = 99.45%

Analysis by Peters, Hess (08a), of magnesite from veins in serpentine at Burnetts ranch, 3 miles northeast of Coyote, gave:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	CO_2
0.30	0.16	0.38	1.34	45.86	51.80 = 99.84%

It occurred at the Madrone Magnesite mine, near Madrone. Euhedral magnesite crystals up to 8 mm in length showing the forms $(21\bar{3}1)$, (0001), $(11\bar{2}0)$, and $(02\bar{2}1)$ were described by Rogers (23)

from the San Juan quicksilver mine, 5 miles south of San Jose. An analysis by K. S. Boynton gave:

MgO	CaO	FeO	CO_2	H_2O	insol.
46.26	1.74	1.27	50.48	nil	nil = 99.75%

Sonoma County: There are numerous veins of magnesite in the serpentine of the county. Analyses: 1. Veins 4 miles north of Cloverdale, called the Creon deposit, occur in serpentine dikes; 2. Eckert ranch deposit 2 miles east of Cloverdale; 3. Gillam Creek deposit on steep west side of creek, about 7 miles northwest of Guerneville; 4. Red Slide deposit in valley of East Austin Creek, about 8½ miles north of Cazadero. Analyses by Peters, Hess (08a).

	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	CO_2
1.	1.60	0.25	1.09	1.04	45.20	50.43 = 99.61%
2.	0.51	1.98	0.16	0.59	45.84	50.80 = 99.88%
	0.23	0.04	0.20	0.19	46.88	51.57 = 99.11%
3.	3.51	1.10	0.80	1.46	43.65	49.16 = 99.68%
4.	7.67	0.26	0.29	0.04	43.42	48.08 = 99.76%

A deposit of magnesite occurs 6 miles north of Healdsburg.

Stanislaus County: The Bald Eagle and Quinto claims on Quinto Creek in Sec. 32, T. 8 S., R. 7 E., M. D. M., near Gustine, have been leading producers of magnesite in recent years. The Smith mine near Patterson has also produced magnesite. Several deposits have been worked on the east side of Red Mountain near the Santa Clara County line.

Tulare County: A large amount of magnesite has been mined from veins on hills about 4 miles northeast of Porterville. Analyses: 1. From the Deer Creek deposit, about 8 miles southeast of Porterville, analyzed by Bates; 2. On the hills about 4 miles northeast of Porterville, analyzed by (a) Peters, (b) Hanks; 3. From veins in Secs. 30 and 31, T. 22 S., R. 29 E., M. D. M., on the South Fork of Tule River, analyzed by Peters, Hess (08a).

	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	CO_2	H_2O
1.	0.31	0.11	0.08	0.24	47.22	51.64	--- = 99.60%
2. (a)	2.28	0.03	0.26	1.32	45.17	50.74	--- = 99.80%
(b)	0.90	0.49		1.49	44.39	50.06	2.57 = 99.90%
3.	0.80	0.42	0.20	1.02	45.94	51.30	--- = 99.68%

Small veins of it also occur in Round Valley, about 4 miles east of Lindsay; on Rocky Hill, about 2 miles east of Exeter, with californite; near Naranjo with white opal; and near Auckland. A deposit of magnesite at the Alpha claim 3½ miles east of Strathmore is of high grade.

Tuolumne County: There are several deposits of magnesite in T. 1 S., R. 14 E., M. D. M., near Chinese Camp, from at least two of which commercial shipments have been made, Bradley (25).

SIDERITE

Ferrous carbonate, $FeCO_3$.

Hexagonal-rhombohedral; scalenohedral. Crystals with curved faces; also massive, granular. Cleavage perfect rhombohedral. Brittle. Vitreous to pearly luster. Color ash-gray to dark-brown. Streak white. H. = 3½ — 4. G. = 3.8.

Becomes magnetic on heating. Dissolves with brisk effervescence in hot hydrochloric acid.

Siderite is occasionally found in the mining regions in drusy crystallizations associated with pyrite and galena, but does not appear to be common in California.

Calaveras County: Siderite occurs with albite, calcite, and quartz at Campo Seco.

El Dorado County: It occurs with calcite and albite at the Red Hill mine, Kelsey mining district.

Imperial County: It occurs with specular hematite in quartz, near Bard.

Inyo County: Masses of siderite have been found at the Custer mine, Coso district. Siderite occurs with pyrite, pyrrhotite, and chalcopyrite in a quartz vein at the Curran mine, half a mile northeast of Panamint, Sampson (32).

Los Angeles County: Massive siderite occurs in the Tujunga Canyon.

Mariposa County: It was found with calcite at Devils Gulch.

Mono County: It occurs with limonite and hematite near Benton.

Plumas County: It was found with the copper minerals of the Engels mine.

Santa Clara County: A deposit of siderite occurs on the Weber ranch, in Los Animos Hills, 3 miles northeast of Madrone; large masses on Red Mountain; on Coyote Creek 4½ miles east of Madrone; small irregular bunches 3 miles east of Coyote on the western slope of Metcalf Canyon.

Shasta County: According to Fairbanks (93) siderite occurs in large masses in this county east of the Stillwater region.

RHODOCHROSITE

Manganese carbonate, $MnCO_3$.

Hexagonal-rhombohedral; scalenohedral. Small crystals and massive. Cleavage perfect rhombohedral. Brittle. Vitreous luster. Color rose-red or gray. Streak white. H. = 3½ — 4½. G. = 3.45 — 3.60.

Its effervescense with acid, and wine or amethystine bead with borax serve to distinguish it.

Alameda County: Rhodochrosite, both gray and pink, occurs commonly in the psilomelane mines of the Tesla district, southeast of Livermore. It occurs with psilomelane on the Arroyo Mocho road,

southeast of Livermore. It was found at the Merchant mine, 9 miles southeast of Livermore, Bradley, et al (18).

Alpine County: Pink crystals of rhodochrosite were found in the Colorado mine No. 2, Monitor district, Irelan (87).

Amador County: It occurs with psilomelane 4 miles east of Pine Grove.

Butte County: It was found on the North Fork of Feather River.

Madera County: It occurs near Coarse Gold.

Mariposa County: Gray and red rhodochrosite is associated with psilomelane in Indian Gulch.

Mendocino County: It occurs in the Mount Sanhedrin group at Impassable Rock.

Placer County: Small druses of rhodochrosite have been found in some of the mines of the county.

San Bernardino County: It occurs at the New York mine near Manvel. It has been reported as a vein mineral in quartz at the Sagamore mine, New York Mountains.

San Joaquin County: It occurs in the Ladd mine of Corral Hollow.

Santa Clara County: Rhodochrosite occurred as pink crystals showing the steep negative rhombohedron ($0\bar{2}21$) with occasionally the unit rhombohedron ($10\bar{1}1$), in the manganese boulder near Alum Rock Park, 5 miles east of San Jose, Rogers (19a).

Sonoma County: Massive gray rhodochrosite occurs with psilomelane at the Aho property 6 miles west of Cazadero.

Stanislaus County: It was found with calcite and pyrolusite in the Buckeye Manganese mine, Hospital Creek.

SMITHSONITE

Zinc carbonate, $ZnCO_3$.

Hexagonal-rhombohedral; scalenohedral. Drusy crystals, usually reniform, botryoidal or stalactitic; often bone-like. Cleavage perfect rhombohedral. Brittle. Vitreous luster. Color white, grayish, bluish, greenish, brownish. Streak white. H. = 5½. G. = 4.30 — 4.45.

B. B. infusible. With sodium carbonate on charcoal, becomes yellow while hot and white when cold. Moistened with cobalt nitrate and intensely heated, assumes the yellowish-green color characteristic of zinc minerals. effervesces readily in hydrochloric acid.

Smithsonite is a secondary mineral often found in silver-lead districts. It is usually associated with galena, sphalerite, hemimorphite (calamine), and cerusite.

Inyo County: Smithsonite was found with cerusite at the Modoc mine, Cerro Gordo, Hanks (84). It was also present at the Ignacio mine with hemimorphite and willemite. An unusual stalactite form of smithsonite occurs at Cerro Gordo. It occurs with hemimorphite at Camp Burgess. It was found in the limestone footwall of the Cerro Gordo mine. It occurred with cerusite and galena in limestone at the Redwing and Noonday mines, Resting Springs district. It was common at the Mineatta mine. It occurred with galena and cerusite in limestone at the Ophir mine. Yellow, cadmium-bearing smithsonite was obtained in the Cerro Gordo mine.

Kern County: Smithsonite occurred in drusy veins at the Jewett mine on Cottonwood Creek.

San Bernardino County: It occurred with hemimorphite at the Cuticura mine, near Daggett. It occurred with cerusite, anglesite, linarite, and galena in dolomite at the Ibex mine, Black Mountains, 6 miles north of Saratoga Springs. It was found at the Ophir mine, in the Slate Range.

DOLOMITE

Carbonate of calcium and magnesium, $CaMg(CO_3)_2$.

Hexagonal-rhombohedral; rhombohedral. Crystals usually with curved faces; also granular, coarse or fine. Cleavage perfect rhombohedral. Brittle. Vitreous luster. Color white, pink, green, brown, gray, black. $H. = 3\frac{1}{2} - 4$. $G. = 2.8 - 2.9$.

Effervesces feebly in cold dilute acids. Best distinguished from calcite in the wet way. After removal of the calcium by its precipitation with ammonium oxalate, the magnesium is obtained from the filtered solution by precipitating with sodium phosphate.

Dolomite is a common mineral, but is not so abundant as calcite. Much of the limestone and marble af the State is dolomitic. Dolomite is commonly associated with serpentine and other magnesian rocks, in which it is often found as white veins.

Alameda County: Dolomite occurs in the manganese district about 15 miles southeast of Livermore.

Calaveras County: White crystals of dolomite occurred in the gold-bearing schist of Carson Hill.

El Dorado County: A large vein of dolomite occurs at the Laskin mine, half a mile east of Diamond Springs.

Inyo County: The variegated and white marbles of the Inyo Mountains are dolomitic. Good crystals of dolomite were found in the San Felipe mine. A commercial body of dolomite occurs at the Bodgley quarry, 4 miles north of Keeler.

Monterey County: It occurs at Natividad. A large deposit of dolomite occurs along the foothills, 6 miles east of Salinas.

Nevada County: Dolomite occurs as veins in the serpentine rocks at Nevada City.

Orange County: A mass of dolomite with gypsum occurs in Gypsum Canyon on the western slope of the Santa Ana Range.

Plumas County: Siliceous dolomite is common in the Diadem lode.

Riverside County: Dolomite occurs in the Eagle Mountains.

San Benito County: Pure white dolomite is found in a large body about 10 miles southwest of Hollister. Crystals of dolomite occur at the Sampson Magnesite mine near New Idria.

San Bernardino County: Gray dolomite near the head of Arctic Canyon in the SW¼ Sec. 16, T. 3 N., R. 1 E., S. B. M., has been analyzed by Woodford and Harris (28).

CaO	MgO	R_2O_3	Residue
31.2	19.7	0.4	1.4%

Dolomite occurs as a gangue mineral with the ores of the Rand district, Hulin (25).

San Luis Obispo County: A vein of white dolomite occurs in Little Falls Canyon, Laizure (25).

Santa Clara County: Drusy coatings of white dolomite crystals occurred in the New Almaden and Guadalupe quicksilver mines.

Tuolumne County: Dolomite is a common associate of the mariposite schists of the mines near Jamestown. Part of the limestone near Columbia and Sonora is dolomite.

ANKERITE

Carbonate of calcium, magnesium, iron, and manganese, $CaCO_3.(Mg,Fe,Mn)CO_3$.

Hexagonal-rhombohedral; rhombohedral. In rhombohedral crystals. Also crystalline massive, granular. Cleavage like calcite. Luster vitreous to pearly. Color white to brown. H. = 3½ — 4. G. = 2.95 — 3.1.

B. B. like dolomite, but darkens in color; with the fluxes reacts for iron and manganese. Soluble with effervescence in the acids.

Ankerite is sometimes classed as an iron-bearing dolomite. It is commonly associated with the gold-bearing schists of the Mother Lode region, especially with the green mica, mariposite.

Amador County: It occurred in the quartz filling of the veins of the Plymouth mine at Plymouth, Knopf (29).

Calaveras County: It was abundant at Carson Hill, Knopf (29).

Mariposa County: Ankerite was first reported by Silliman (67a) as an associate of mariposite on the Mariposa estate. It was promi

nent in mariposite schists at the Josephine mine. It occurred at the Mary Harrison mine, 1 mile south of Coulterville, Knopf (29).

Nevada County: Ankerite collected by W. D. Johnston, Jr., from the North Star mine at Grass Valley has been analyzed by Fairchild, Wells (37).

Insol.	CaO	MgO	FeO	MnO	CO_2	H_2O	Fe_2O_3
1.46	30.64	11.38	12.52	0.31	43.30	0.40	0.32 = 100.33%

San Bernardino County: Ankerite occurs with the tungsten deposits near Atolia, Hulin (25).

Tuolumne County: It was common on Quartz Mountain, at the Rawhide Ranch mine near Tuttletown, and the Eagle Shawmut mine on Woods Creek. Analysis of ankerite from the Eagle Shawmut mine by Smith, Knopf (29).

CaO	MgO	FeO	MnO	CO_2	Insol.
32.13	16.57	3.85	0.43	46.14	0.98 = 100.10%

ARAGONITE GROUP

ARAGONITE

Calcium carbonate, $CaCO_3$.

Orthorhombic. Slender prisms, columnar, fibrous, stalactitic, massive, and coralloidal. Cleavage (010) distinct; also (110). Brittle. Vitreous luster. Colorless, white, brown, yellow, green. Streak uncolored. H. = $3\frac{1}{2}$ — 4. G. = 2.93 — 2.95.

Distinguished from calcite by its action with cobalt nitrate. The powder boiled in a solution of cobalt nitrate turns violet, and the solution also assumes this color, whereas caclite has no effect on the solution. Other reactions the same as for calcite.

Much of the banded onyx marble of the State has been erroneously called aragonite.

Flos-ferri is a fine snow-white branching stalactitic form of aragonite.

Alameda County: Pale-brownish columnar masses of aragonite occur in a limestone quarry near Patterson Pass, 7 miles east of Livermore.

Calaveras County: Fine stalactites of flos-ferri have come from a cave near Murphy. Fine masses of aragonite have been found in the Morgan mine, Carson Hill.

Colusa County: It was found with sulphur at Sulphur Creek, Fairbanks (94). Masses of aragonite have come from the Candace mine.

Inyo County: Fine specimens of aragonite have been reported from an abandoned mine in Titus Canyon in the Leadfield district by McIntosh (34), and by Melhase (34).

Kern County: Concretions of aragonite occur with gypsum in a bed of sand or silt near the south end of the Kettleman Hills, Sec. 10, T. 25 S., R. 19 E., M. D. M., Reed (26).

Lake County: It occurs with opal in lava at Sulphur Banks, Anderson (36).

Madera County: Acicular crystals of aragonite occur in cavities in the copper deposit at Becks Lakes, Goudey (36).

Placer County: It is reported to occur at Gold Run.

Riverside County: Small amounts of fibrous aragonite were found at Crestmore, Eakle (17).

San Benito County: It occurs as bunches and stringers in the rocks adjoining the benitoite veins near the headwaters of the San Benito River, Louderback (09).

San Bernardino County: It is said to have occurred with priceite, probably from Calico, Silliman (73b). It occurs with calcite in the limestone of the Slover Mountains, near Colton.

San Francisco County: It was found as thin veins in the serpentine of Fort Point, Eakle (01).

Solano County: Aragonite is formed at the Tolenas Springs.

Tuolumne County: It occurs as bunches in the basaltic rock of Table Mountain.

STRONTIANITE

Strontium carbonate, $SrCO_3$.

Orthorhombic. Crystals acicular. Columnar masses, fibrous, granular. Cleavage prismatic. Vitreous luster. Color white, gray, pale-green, and yellowish-brown. Streak white. $H. = 3\frac{1}{2} - 4$. $G. = 3.68 - 3.71$.

Effervesces in acid like calcite. Distinguished from calcite by its permanent deep-crimson flame obtained by taking a little of the powder on a platinum wire moistened with hydrochloric acid and holding it in a colorless Bunsen flame.

Inyo County: A deposit of brown massive strontianite occurs 3 miles west of Shoshone.

Plumas County: Large masses of divergent columnar strontianite were found in the Genessee Valley.

San Bernardino County: Large deposits of strontianite ocur as brown fibrous and gray granular masses in limestone in the Mud Hills, or Strontium Hills, 10 miles north of Barstow, Knopf (18). Celestite and gypsum are associated. Partial analysis by R. C. Wells

SrO	CaO	BaO	SO_3	CO_2 (computed)
60.99	6.40	none	0.05	29.86 = 97.30%

WITHERITE

Barium carbonate, $BaCO_3$.

Orthorhombic. Seldom in good crystals. Usually massive, columnar or granular. Cleavage (010) distinct. Vitreous luster. Color white, yellowish, grayish. Streak white. H. = 3. G. = 4.27 — 4.35.

Fusible. Gives alkaline reaction on turmeric paper. Easily soluble with effervescence in hydrochloric acid. On adding sulphuric acid, barium sulphate is precipitated. Gives green flame of barium.

Mariposa County: Massive witherite occurs with barite in the deposit near El Portal, W. W. Bradley (31), Fitch (31). It is also found with barite in the Devils Gulch, Secs. 17 and 20, T. 4 S., R. 20 E., M. D. M.

Shasta County: It occurs massive on Beegum Creek, near Platina.

CERUSITE—White Lead Ore

Lead carbonate, $PbCO_3$.

Orthorhombic. Platy crystals. Generally massive. Cleavage (110) and (021) distinct. Fracture conchoidal. Very brittle. Adamantine to vitreous luster. Color gray, cream-white, brown. Streak uncolored. H. = 3 — 3½. G. = 6.46 — 6.57.

Easily fusible. Fused on charcoal with sodium carbonate, reduces to metallic globules of lead and gives yellow coating. Soluble in nitric acid with effervescence.

Cerusite is a common alteration product of galena, and in all mines having much galena it is found in the oxidized portion of the veins. It generally occurs as heavy gray or brown masses, but is occasionally found in cream-white platy crystals in the porous ore and galena cavities. In silver districts it is frequently rich in silver and forms the chief ore.

Imperial County: It occurs in small veins and pockets 5 miles east of Picacho.

Inyo County: Large crystals of cerusite were found in the Russ district, W. P. Blake (66). It is common in the Cerro Gordo and other silver districts of the county. It occurred with galena at the Montezuma mine, 10 miles southeast of Big Pine; with galena and smithsonite in limestone at the Ophir mine, Slate Range; with smithsonite at the Redwing mine; at the Santa Rosa mine, Lee district; with smithsonite in limestone at the Ventura mine; in the Carbonate mine; with galena and smithsonite at the Noonday mine; large crystals with anglesite at the Ubehebe mine; with galena, chalcopyrite, and native copper in limestone at Chloride Cliff, Grapevine Range.

Kern County: It occurred with galena 7 miles northwest of Randsburg.

Madera County: Cerusite is reported to occur with the lead ores of the Minaret district, Goudey (36).

Mono County: It is common in the Blind Spring Hill district, Goodyear (88).

Riverside County: Cerusite occurs with galena in gold-bearing quartz at the Free Coinage and Steel mines, Hodges district. Cerusite occurs in small amounts as an alteration of galena at Crestmore, Eakle (17).

San Bernardino County: Cerusite was prominent in the horn silver districts of Calico and Barstow, Lindgren (87), Storms (90). It is very prominent in the Silver Reef district, near Oro Grande. It occurs with smithsonite at the Silver Rule mine, a quarter of a mile south of the Inyo County line. It occurs with smithsonite, anglesite, linarite, and galena in dolomite at the Ibex mine, 6 miles north of Saratoga Springs.

Shasta County: Cerusite was reported by W. P. Blake (67) from the silver ore of the Chicago claim, 3 miles west of Igo.

BISMUTOSPHÄRITE

Carbonate of bismuth, $Bi_2(CO_3)_3.2Bi_2O_3$.

In spherical forms with radiated structure. Yellow to gray or blackish-brown. H. = 3 — 3½. G. = 7.3 — 7.4.

Easily fusible. Effervesces in acid. Mixed with potassium iodide and sulphur and fused on charcoal, it gives a bright-red coating on the outer edge of a yellow coating.

This very rare mineral is formed by the alteration of native bismuth or bismuthinite, and is always of secondary origin.

San Diego County: Bismutosphärite occurs in grayish-black masses and as a yellow powder from the alteration of native bismuth at Pala, Schaller (04a).

PHOSGENITE

Chlorocarbonate of lead, $(PbCl)_2CO_3$.

Tetragonal. Prismatic crystals. Cleavage (110), (100) and (001) distinct. Adamantine luster. Color white to yellow. Streak white. H. = 2¾ — 3. G. = 6.0 — 6.3.

Easily fusible to yellow bead. Reduced with sodium carbonate to metallic lead. Fused with copper oxide, it gives blue flame of copper chloride. Effervesces with dilute nitric acid.

Inyo County: Phosgenite in acicular, straw-yellow crystals in quartz came from the Silver Sprout mine, Hanks (84).

NORTHUPITE

Double carbonate of magnesium and sodium with sodium chloride, $MgCO_3.Na_2CO_3.NaCl$.

Isometric. Octahedral crystals. Vitreous. White to yellow or gray. H. = 3½ — 4. G. = 2.38.

Easily fusible. Soluble in dilute acid.

Northupite is only known to occur in this State.

Lake County: It occurs with gay-lussite and pirssonite in trona at Borax Lake, Vonsen and Hanna (36).

San Bernardino County: Some small octahedrons of northupite were discovered in 1895 at Searles Lake and named by Foote (95). An analysis was made by Pratt (96).

CO_2	Cl	SO_3	MgO	Na_2O	H_2O	insol.		O for Cl	
35.12	14.10	0.08	16.08	36.99	0.72	0.22	= 103.31	— 3.16	= 100.15%

TYCHITE

Carbonate of sodium and magnesium with sodium sulphate.
$2MgCO_3.2Na_2CO_3.Na_2SO_4$.

Isometric. Small octahedral crystals. Vitreous. White. H. = 3½ — 4. G. = 2.58.

Similar to northupite in its reactions.

San Bernardino County: A few small octahedrons of tychite were mixed with the northupite crystals discovered at Searles Lake. They were analyzed and named by Penfield and Jamieson (05).

SO_3	CO_2	MgO	Na_2O	
15.08	33.55	15.83	35.49	= 99.95%
15.06	33.45	15.77	35.65	= 99.93%

HYDROUS CARBONATES

MALACHITE

Basic cupric carbonate, $CuCo_3.Cu(OH)_2$.

Monoclinic. Crystals usually slender, grouped in tufts and rosettes. Commonly massive or incrusting, botryoidal reniform or stalactitic. Cleavage (001) perfect. Brittle. Luster of crystals adamantine to vitreous; of fibrous varieties more or less silky. Color bright-green. Streak pale-green. H. = 3½ — 4. G. = 3.9 — 4.03.

B. B. fuses at 2, coloring the flame emerald-green; on charcoal is reduced to metallic copper. In the closed tube blackens and yields water. Soluble in acids with effervescence.

Malachite is found in practically every locality where ores of copper occur, and is the product of their alteration.

Amador County: Fine reniform masses of malachite have come from Volcano.

Calaveras County: It occurred at Campo Seco and Copperopolis. Fine specimens of malachite came from the old Hughes mine, W. P. Blake (66).

Del Norte County: It occurs with magnetite and chalcocite at French Hill; with chalcopyrite and bornite at the Diamond mine, Low Divide; with magnetite at the Morning Star mine, Rockland district.

Humboldt County: Excellent specimens of malachite have come from Horse Mountain; also from the Mattole district.

Inyo County: Good drusy malachite occurred in the Cerro Gordo district. It was found with chrysocolla 10 miles east of Death Valley Junction.

Kern County: It is found with azurite in San Emigdio Canyon.

Kings County: It has been observed at Anshall Creek.

Lake County: Malachite occurs on the Langtry ranch, 7 miles south of Middletown.

Lassen County: It occurred with azurite at the Copper King mine, near Westwood.

Los Angeles County: It occurs with azurite on the Upper San Gabriel River.

Mariposa County: Fine drusy coatings and excellent crystallized malachite occur at the White Rock mine. It occurred with azurite at the Peterson and Cornet mines.

Mendocino County: Malachite occurs with native copper in serpentine at Red Mountain, 10 miles southeast of Ukiah. It occurs as an alteration of chalcopyrite in Anderson Valley.

Mono County: Malachite occurs in the Blind Spring Hill district. Malachite with cuprite and melaconite occurs at the Detroit mine.

Monterey County: Malachite has been observed in the serpentine, east of Parkfield.

Napa County: It occurred with some covellite and chalcocite in the Jumper Group of mines. It was found with azurite near Monticello.

Placer County: Malachite occurred in large amounts with native copper at the Algol mine, 9 miles northeast of Lincoln.

Plumas County: Malachite occurs with bornite and chalcocite in Lights Canyon. It occurred in large masses in limestone at the Bluebell mine, Genesee district. It was found with azurite as a vein in the Pettinger mine, near Taylorville. It occurred with chalcocite at Green Ledge, Genesee Valley. Malachite was found as an alteration product of chalcocite and bornite at the Oregon, Olympia, Polar Star, and Engel mines. It occurs with hematite and yellow limonite in a barite gangue in Cooks Canyon.

Riverside County: It was observed as an alteration product of chalcopyrite in the Monte Negro district. It occurs with azurite and cuprite in the McCoy, Palen, and Santa Maria Mountains. It occurs as an alteration product of copper sulphides at Crestmore, Eakle (17).

San Benito County: It occurred with azurite at the Towle Copper mine near Elkhorn.

San Bernardino County: Malachite was found in the Calico district. It is common in the copper ores of the eastern part of the county. It occurs with chalcocite and bornite 4 miles east of Judson.

San Diego County: Excellent specimens of malachite have come from 3 miles south of Julian.

San Luis Obispo County: It occurs on the Santa Lucia Mountains and on Chorro Creek.

Shasta County: Malachite occurs with azurite at the Greenhorn mine, in the French Gulch district.

Trinity County: It has been observed on Dobbyn Creek. It occurred sparingly at the Copper Queen lode, Carrville. It occurs as a secondary mineral at Island Mountain.

Tuolumne County: Malachite occurs with chalcopyrite at the Greenstone mine.

AZURITE

Basic cupric carbonate, $2CuCO_3.Cu(OH)_2$.

Monoclinic. Good crystals, massive, earthy. Cleavage (021) perfect. Brittle. Vitreous to adamantine luster. Color deep azure-blue. Streak light-blue. H. = $3\frac{1}{2}$ — 4. G. = 3.77 — 3.89.

Similar to malachite in reactions, but easily distinguished by color.

The blue azurite is not so common as the green malachite with which it is usually found. It occurs generally in aggregates of distinct crystals, often lining cavities in limonitic and malachitic masses. Azurite is formed in most copper districts as an oxidation mineral and is of secondary origin.

Butte County: It was observed with malachite near Bangor.

Calaveras County: Fine crystals of azurite occurred with malachite at the old Hughes mine, W. P. Blake (66). Azurite with malachite has been found in the Santa Cruz mine, near Robinsons Ferry; also at the Telegraph mine, Hog Hill.

El Dorado County: Good specimens of azurite and malachite have come from the Alabaster Cave mine, Cave City.

Inyo County: It occurs with melaconite, malachite, and chrysocolla in the Greenwater district, Black Mountains; at the Mountain View mine, Panamint; with pink and white lepidolite at the Half Dollar mine.

Kern County: In the Cinco district it is associated with malachite, galena, anglesite, and cerusite. Fine specimens have come from San Emigdio Canyon.

Lassen County: It occurred with malachite near Westwood.

Madera County: It occurred with malachite in the old Buchanan mine.

Mariposa County: Fine crystals of azurite occur in the Hawlington district. It was observed in the White Rock mine.

Modoc County: It occurs 7 miles south of Fort Bidwell with malachite, cuprite, and native copper.

Mono County: Crystals of azurite on limonite from the Diana mine had the forms: (001), $(\bar{1}02)$, (012), (011), (110), and (111), Jackson (86).

Napa County: Azurite and malachite have been found near Monticello.

Placer County: Small amounts of azurite were observed in the copper mines 7 miles north of Auburn.

Plumas County: It occurred with malachite near Taylorsville at the Pettinger and Polar Star mines.

Riverside County: It occurs in the McCoy and Palen Mountains with malachite and cuprite. Azurite is associated with malachite at Crestmore, Eakle (17).

San Benito County: Small crystals of azurite occurred at the Towle Copper mine, near Elkhorn.

San Bernardino County: It occurs with malachite in the Signal mining district. Specimens of azurite have come from the Bumper claims, near Needles.

Shasta County: Azurite occurs with malachite at the Greenhorn mine, in the French Gulch district.

Siskiyou County: It occurred with malachite near Gazelle and in the Bonanza mine, near Honolulu.

Sonoma County: Small perfect crystals of azurite with malachite occur 8 miles northeast of Cazadero.

Trinity County: It occurs with malachite at Island Mountain.

Tuolumne County: It was observed at Whiskey Hill, and in various mines of the county in small amounts.

AURICHALCITE

Basic carbonate of zinc and copper, $2(Zn,Cu)CO_3.3(Zn,Cu)(OH)_2$.

Monoclinic. Plumose, tabular, laminated; in drusy incrustations. Pearly luster. Color and streak pale-green to sky-blue. H. = 2. G. = 3.54 — 3.64.

On charcoal, when mixed with sodium carbonate, it gives yellow coating of zinc and globules of copper. Easily soluble with effervescence. In a closed tube blackens and gives water.

This is a very rare mineral of secondary origin and has only been found in two localities in the State.

Inyo County: At the Cerro Gordo mine, aurichalcite occurs in pale bluish-green acicular crystals and tufts in cavities, with hemimorphite, Rogers (12).

Mono County: It occurs as pale-green fissure fillings in magnetite containing sphalerite, near Topaz.

HYDROZINCITE

Basic zinc carbonate, $2ZnCO_3.3Zn(OH)_2$.

Monoclinic. Minute crystals, thin blades parallel to a perfect cleavage, either (100) or (001). Usually massive or earthy, as incrustations. Dull luster. Color white, grayish, yellowish. H. = 2 — 2½. G. = 3.58 — 3.8.

B. B. Infusible. Intensely heated on charcoal with cobalt nitrate, will assume green color of zinc. Soluble with effervescence in dilute acid. Gives water in closed tube.

Hydrozincite is of secondary origin, formed usually by the alteration of sphalerite.

Inyo County: Thick layers of hydrozincite occur at the Cerro Gordo mine with sphalerite, willemite, and hemimorphite (calamine), Rogers (12).

DAWSONITE

Basic carbonate of aluminum and sodium, $Na_3Al(CO_3)_3.2Al(OH)_3$.

Orthorhombic. In thin crusts of white radiating acicular or bladed crystals. Perfect cleavage, (110). H. = 3. G. = 2.4.

Swells and fuses, coloring flame deep-yellow and fused mass gives an alkaline reaction. With cobalt nitrate gives a fine blue color. Gives water in a closed tube. Effervesces easily.

Dawsonite is a very rare mineral, and occurs only in arid regions as white incrustations.

Inyo County: It is reported to occur as a soft earthy incrustation in a dike in Amargosa Canyon, Bailey (02).

THERMONATRITE

Hydrous sodium carbonate, $Na_2CO_3.H_2O$.

Orthorhombic. Vitreous. White, grayish-yellow. H. = 1 — 1½. G. = 2.25.

Gives strong yellow flame of sodium and an alkaline reaction on heating. Soluble in water and has an alkaline taste.

Thermonatrite occurs as an efflorescence in dry regions.

Inyo County: It forms white efflorescent coatings in Death Valley, according to Bailey (02).

NESQUEHONITE

Hydrous magnesium carbonate, $MgCO_3.3H_2O$.

Orthorhombic. In prismatic crystals, usually united in radiating groups. Cleavage perfect (110). Colorless to white. Transparent to translucent. H. = 2.5. G. = 1.84.

San Benito County: Nesquehonite is reported as occurring with hydromagnesite near the Florence Mack quicksilver mine, south of New Idria.

NATRON

Hydrous sodium carbonate, $Na_2CO_3.10H_2O$.

Monoclinic. Tabular crystals obtained by the evaporation of waters from soda lakes. Brittle. Vitreous to earthy. White, gray, or yellow. H. = 1 — 1½. G. = 1.42 — 1.46.

Gives intensely yellow flame and reacts alkaline. Soluble in water and effervesces in acids.

Inyo County: Crystals of natron mixed with sodium bicarbonate are obtained by evaporating the water of Owens Lake, and other soda lakes. The waters of Owens Lake have been analyzed by Chatard (89).

PIRSSONITE

Hydrous double carbonate of calcium and sodium, $CaCO_3.Na_2CO_3.2H_2O$.

Orthorhombic-pyramidal. In prismatic crystals. Vitreous. Colorless to white. H. = 3. G. = 2.35.

Similar to gay-lussite in its reactions. Boiled in water the sodium carbonate is leached out and causes the solution to become strongly alkaline.

Pirssonite was discovered in California in 1896 and is known from only two localities.

Lake County: It occurs with gay-lussite and northupite in trona at Borax Lake, Vonsen and Hanna (36).

San Bernardino County: Good crystals of pirssonite were found with northupite, gay-lussite, and hanksite at the New Well, Searles Lake. Pirssonite was described and named by Pratt (96). Forms: (010), (110), (111), ($11\bar{1}$), (131), and (311).

CO_2	CaO	Na_2O	K_2O	H_2O	Al_2O_3	SiO_2	
36.07	23.38	25.70	0.15	14.73	0.13	0.29 =	100.45%
							G. = 2.352.

GAY-LUSSITE

Hydrous carbonate of calcium and sodium, $CaCO_3.Na_2CO_3.5H_2O$.

Monoclinic. Crystals often elongated; also flattened wedge-shaped. Cleavage perfect prismatic. Fracture conchoidal. Very brittle. Vitreous luster. Color white, yellowish-white. Streak uncolored to grayish. H. = 2 — 3. G. = 1.93 — 1.95

Easily fusible to a white enamel with strong yellow flame. Gives alkaline reaction on turmeric paper. Easily effervesces in acide. Gives water in closed tube. Calcium shown by precipitation with ammonium oxalate.

This double carbonate is frequently formed on the shores of soda lakes. Found only in dry regions.

Lake County: It occurs with northupite and pirssonite in trona at Borax Lake, Vonsen and Hanna (36).

Mono County: It was found in crystals on the shore of Mono Lake.

San Bernardino County: It is one of the minerals of Searles Lake, Hanks (92). The forms of the gay-lussite crystals from this

lake as determined by Pratt (96) are: (010), (001), (110), (011), ($\bar{1}$01), and ($\bar{1}$12). Bailey (02) mentions it as occurring at the Owl Springs niter beds.

TRONA—Urao

Hydrous carbonate and bicarbonate of sodium, $Na_2CO_3.HNaCO_3.2H_2O$.

Monoclinic. In plates or slender crystals; often fibrous or columnar massive. Cleavage perfect orthopinacoidal. Vitreous, glistening. Gray or yellowish-white. H. = 2½ — 3. G. = 2.11 — 2.14.

Like natron in reactions. Yields much water in a closed tube.

Trona is found in the deposits of saline lakes or is produced by the evaporation of their waters.

Inyo County: Trona was reported from the borax deposits of Death Valley by Bodewig and vom Rath (85). White layers of trona occur along the shores of Owens Lake, Chatard (89). Analysis of material formed by evaporation at the edge of the lake shows it to be nearly pure trona.

Insol.	Cl	SO_3	CO_2	Na_2O	H_2O	O = Cl	
0.02	0.19	0.70	38.13	41.00	20.07 = 100.11	— 0.04 =	100.07%
						G. = 2.147.	

Lake County: It occurs at Borax Lake with gay-lussite, pirssonite, and northupite, Vonsen and Hanna (36).

San Bernardino County: Thick layers of solid trona occur with borax, hanksite, thenardite, glauberite, and other salts at Searles Lake. Crystals are very common. They are elongated in the direction of the b axis and have the forms: (100), (001), (101), ($\bar{3}$02), (111), ($\bar{1}$11), (211), Ayers (89a).

HYDROMAGNESITE

Hydrous basic magnesium carbonate, $3MgCO_3.Mg(OH)_2.3H_2O$.

Monoclinic. Crystals small, tufted. Generally massive, chalky crusts. Perfect cleavage (010); distinct (100). Vitreous silky to dull luster. Color and streak white. H. = 3½. G. = 2.16.

B. B. infusible. Effervesces easily in dilute acids.

Hydromagnesite is formed by the alteration of serpentine and other magnesian rocks.

Alameda County: A specimen of hydromagnesite from southeast of Livermore was analyzed by Gutzkow (86). It apparently came from the southwest side of Cedar Mountain.

$SiO_2Al_2O_3Fe_2O_3$	CaO	MgO	CO_2	H_2O	Moisture
1.25	tr.	43.00	36.30	18.70	0.75

Massive white hydromagnesite has been found near Pleasanton.

Colusa County: Hydromagnesite occurs abundantly with serpentine in the Sulphur Creek area. Analysis by Kramm (10).

SiO_2	$Fe_2O_3.Al_2O_3$	CaO	MgO	CO_2	H_2O
9.37	tr.	2.46	39.25	29.45	18.74 = 99.27%

Inyo County: It is said to occur in chalky and mealy crusts along the Amargosa River, Bailey (02).

Riverside County: Crystals of hydromagnesite occur in the calcite at Crestmore as an alteration product of brucite, Eakle (17).

San Benito County: Hydromagnesite occurs with magnesite in powdery white balls, on Larious Creek, on the slope of Sampson Peak, and was analyzed by W. B. Hicks. The deposit was described by Gale (14d).

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	CO_2	undet.	Ign. loss
2.50	0.13	0.44	0.34	41.60	34.89	20.10 = 100%	54.10

Hydromagnesite is also reported, with nesquehonite, near the Florence Mack quicksilver mine, south of New Idria.

San Francisco County: Radiating rosettes of hydromagnesite occur on the serpentine at Fort Point. Small white veins of it are found in the serpentine of San Francisco.

San Luis Obispo County: Small veins of hydromagnesite were found in the rocks near Port San Luis.

San Mateo County: Hydromagnesite occurs in small patches in serpentine near Searsville Lake, Rogers (23a).

Santa Clara County: It was found in serpentine in Alum Rock Canyon and in the Calaveras Valley, Rogers (23a).

ZARATITE

Hydrous carbonate of nickel, $NiCO_3.2Ni(OH)_2.4H_2O$.?

Amorphous. In mammillary incrustations; also massive compact. Brittle. Vitreous luster. Color emerald-green. Streak green. H. = 3. G. = 2.6.

B. B. infusible. Imparts to the borax bead a brown color which, when reduced, becomes gray and cloudy. Effervesces in hot acid. Gives water in closed tube.

Zaratite is always accompanied by chromite, occurring as an incrustation on massive chromite. Most of the green coatings on the chromite of the State, however, consist of small uvarovite garnet crystals or green chlorite.

Alameda County: Green coatings of zaratite occur on the chromite at the Mendenhall mine on Cedar Mountain.

Madera County: It was found as a coating on chromite near Madera.

Monterey County: It was found on the chromite in this county, W. P. Blake (66).

San Benito County: Zaratite was found on chromite near Hollister and near Panoche.

Shasta County: It was observed on the chromite at Castella.

Siskiyou County: Green coatings of zaratite occur on the chromite near Callahan.

BISMUTITE

Basic bismuth carbonate, $Bi_2O_3.CO_2.H_2O$.?

Incrusting fibrous, or earthy and pulverulent. Vitreous to dull luster. White, green, yellow and gray. Streak greenish-gray. H. = 4. G. = 7.

Fused on charcoal with potassium iodide and sulphur, it gives a red coating. A small amount of water is obtained by heating in a closed tube. Effervesces in acid.

Bismutite is of secondary origin, being derived chiefly by the alteration of bismuthinite and native bismuth.

Fresno County: Bismutite occurred at the Second Sierra and Lot One mines, Kings River district.

Inyo County: It was found at Big Pine Creek, Hanks (84); also at Antelope Springs, Deep Spring Valley. Fibrous and crypto-crystalline specimens of bismutite have come from near Lone Pine.

Los Angeles County: White earthy bismutite has been found in this county.

Mono County: It was found at Oasis.

San Bernardino County: It occurs as an alteration of bismuthinite at the United Tungsten Copper mine, Morongo district.

ADDENDUM TO BORATES

(see pp. 161 and 162)

VEATCHITE

Hydrous calcium borate, $Ca_2B_6O_{11}.2H_2O$.

Monoclinic. Fibrous veins. Cleavage perfect clinopinacoidal and imperfect basal. Vitreous luster. Colorless. H. = 2. G. = 2.69.

Fuses easily with intumescence. Yields water in closed tube.

Los Angeles County: Veatchite occurs in small amount with howlite and colemanite at the old colemanite mine at Lang. It was named and described, with analysis by F. A. Gonyer, by Switzer (38).

CaO	B_2O_3	H_2O	Insol.	
31.08	59.03	9.50	0.62	100.23%

BORATES

Ludwigite	Colemanite	Tincalconite
Vonsenite	Meyerhofferite	Borax
Camsellite	Inyoite	Probertite
Howlite	Priceite	Ulexite
Bakerite	Kernite	Hydroboracite
Veatchite		Teepleite

LUDWIGITE

Magnesium and iron borate, $3MgO.B_2O_3.FeO,Fe_2O_3$.

Orthorhombic. Small fibrous masses. Silky luster. Color blackish-green to black. H. = 5. G. = 3.91 — 4.02.

Fusible into a magnetic mass. Soluble in hydrochloric and sulphuric acids, but insoluble in nitric acid. Yellow turmeric paper dipped into the hydrochloric acid solution, turns red when dried. Magnesia can be precipitated by sodium phosphate after the boron and iron have been removed.

El Dorado County: Scaly masses of black ludwigite, associated with calcite, epidote, molybdenite, and chalcopyrite occur at the old Cosumnes copper mine, near Fairplay, Rogers (12).

VONSENITE

Iron and magnesium borate, $3(Fe,Mg)O.B_2O_3FeO.Fe_2O_3$.

Orthorhombic. Imperfect crystals and granular masses. Very brittle. Brilliant metallic luster. Color black. Streak brownish-black. Perfectly opaque and non-magnetic. H. = 5. G. = 4.21.

Fuses easily to a black magnetic mass and gives green flame of boron. Soluble in hydrochloric and sulphuric acids, but unattacked by nitric acid.

Riverside County: Vonsenite was discovered by M. Vonsen in the old city quarry at Riverside and described and named by Eakle (20). Forms on the imperfect crystals are: (010), (110), (210), (140), and (160). The analysis gave:

FeO	MgO	B_2O_3	Fe_2O_3
39.75	10.71	14.12	34.82 = 99.40%

CAMSELLITE

Hydrous magnesium borate, $2MgO.B_2O_3.H_2O$.

Orthorhombic? Fibrous. White. H. < 3. G. = 2.60.
Readily fusible. Soluble in acids.

Marin County: Camsellite occurs as impregnations and coatings on serpentine near Stinson Beach. An analysis by Eakle (25a) gave:

MgO	FeO	B_2O_3	SiO_2	H_2O
46.07	2.46	33.34	7.16	10.94 = 99.97%.

which leads to the formula $2(MgO, FeO).(B_2O_3.SiO_2)H_2O$. Schaller (28a) considers camsellite to be identical with szaibelyite, $2Mg_5B_4O_{11}.3H_2O$.

HOWLITE

Hydrous calcium silico-borate, $H_5Ca_2B_5SiO_{14}$.

Monoclinic. Round nodules, massive, chalky. Dull luster. Color white. H. = 1 — 3½. G. = 2.5.

Fuses easily and colors the flame green. Easily soluble and precipitates silica. Calcium is precipitated with ammonium oxalate from a weak hydrochloric acid solution. Yields water in a closed tube. Gives the boron reaction with turmeric paper.

Howlite is an associate of the other borates, but owing to the silica present it is not utilized, although it contains a large amount of boric oxide. It has been mistaken for pandermite at several borate localities in California.

Inyo County: White scaly masses of howlite occur in veins in Gower Gulch near Ryan.

Los Angeles County: Large masses of compact white howlite are common in the colemanite deposit near Lang. It was described and analyzed by Eakle (11).

B_2O_3	CaO	SiO_2	H_2O	
45.56	28.26	14.81	11.37 = 100%	G. = 2.531.

San Bernardino County: Large masses of howlite are associated with bakerite and ulexite in the Mojave desert, 16 miles northeast of Daggett, Giles (03). Analysis No. 1 is of soft scaly, and No. 2 of hard rock-like material, made by Giles. Analysis No. 3 is of soft white material, made by Wm. Lawson.

	B_2O_3	CaO	SiO_2	H_2O	$MgONa_2O$
1. ----------	44.38	28.45	15.50	11.58	0.09
2. ----------	43.78	28.44	15.33	11.39	1.06
3. ----------	44.32	29.22	15.31	11.44	--- = 100.29%

BAKERITE

Hydrous calcium silico-borate, $8CaO.5B_2O_3.6SiO_2.6H_2O$.

Amorphous. Massive. Color white to faint-green. H. = 4½. G. = 2.7 — 2.9.

Reactions the same as for howlite.

Inyo County: Bakerite occurs in Death Valley at the entrance to Corkscrew Canyon.

San Bernardino County: Bakerite was found in the Mojave Desert, 16 miles northeast of Daggett, associated with howlite and ulexite. It was described and named by Giles (03).

	B_2O_3	CaO	SiO_2	H_2O	$Al_2O_3Fe_2O_3$
White --------------	27.74	34.88	28.45	8.30	0.63
Faint-green ---------	26.85	35.22	28.05	8.66	0.22

VEATCHITE (see p. 160)

COLEMANITE

Hydrous calcium borate, $Ca_2B_6O_{11}.5H_2O$.

Monoclinic. Crystals usually short prismatic. Massive, granular and compact. Cleavage perfect clinopinacoidal. Vitreous to adamantine luster. Colorless, white, yellowish-white, gray. H. = 4 — 4½. G. = 2.42.

Decrepitates violently when touched with hot flame, but finally fuses to a clear glass. Powder on platinum wire, moistened with sulphuric acid,

will give a momentary green flame of boron mixed with reddish flame of calcium. Yields water in a closed tube. Soluble in hot hydrochloric acid with separation of boric acid on cooling.

Inyo County: Colemanite was discovered in the Death Valley region where immense deposits of it occur along Furnace Creek in the Amargosa Range, and near Ryan, Gale (12), Foshag (24). Colemanite was first described by Hanks (83), with analysis No. 1 by Thomas Price. Analyses 2, 3 and 4 by Whitfield (87).

	B_2O_3	CaO	Al_2O_3	Fe_2O_3	MgO	SiO_2	H_2O
1.	(48.12)	28.43	0.60		---	0.65	22.20
2.	50.70	27.31			0.10	---	21.87 = 99.98%
3.	49.56	27.36			0.25	0.44	22.66 = 100.27%
4.	49.62	27.40			0.26	0.47	22.70 = 100.45%

Some colemanite crystals from the Biddy McCarthy mine were shown by Rogers (19) to be pseudomorphs after inyoite. The forms occurring were: (001), (110), (010), and (111). Tabular parallel to base. The crystals were formed by dehydration of inyoite. Important deposits of colemanite with ulexite occur in clay shale near Shoshone, Noble (26).

Kern County: Colemanite occurs with kernite and borax in the Kramer district, Schaller (30).

Los Angeles County: An important and extensive deposit of colemanite which Eakle (11) described as a variety, and called 'neocolemanite,' occurs near Lang. Hutchinson (12) shows it to be identical with colemanite. It occurs as thin and thick seams, almost vertical, and has considerable howlite associated with it. The colemanite has been described and analyzed by Eakle (11). Forms: (001), (010), (100), (210), (110), (230), (011), (021), (201), $(\bar{3}01)$, (241), (231), (221), $(\bar{6}61)$, $(\bar{2}21)$, $(\bar{2}23)$, $(\bar{2}11)$, and $(\bar{2}63)$.

B_2O_3	CaO	H_2O	
49.45	27.76	22.48 = 99.69%	G. = 2.423

Riverside County: Colemanite occurs in the foothills of the San Bernardino Range northeast of Salton Sea.

San Bernardino County: The extensive deposit of colemanite at Borate, in the Calico district near Yermo was discovered in the spring of 1883 and became the principal source of borax before the Death Valley deposits were worked. Beautiful crystals of colemanite in large geodal masses occur with celestite crystals. The colemanite crystals were first described by Jackson (84, 85, 86). Forms: (001), (010), (100), (210), (110), (120), (130), (370), (10.19.0), (011), (021), (201), (101), $(\bar{1}01)$, $(\bar{2}01)$, $(\bar{3}01)$, $(\bar{4}01)$, $(\bar{6}01)$, (111), (311), (711), (10.1.1), (771), (19.19.6), (331), (731), (131), (121), $(\bar{1}11)$, $(\bar{2}21)$, $(\bar{3}31)$, $(\bar{4}11)$, $(\bar{3}11)$, $(\bar{2}11)$, $(\bar{7}21)$, $(\bar{3}21)$, $(\bar{2}31)$, $(\bar{1}21)$, $(\bar{2}41)$, $(\bar{1}31)$, $(\bar{2}32)$, and $(\bar{4}12)$. Additional forms described by Eakle (02) are: (310), (301), $(\bar{5}02)$, $(\bar{8}01)$, (522), (142), (141), (164), (165),

(232), ($\bar{1}$23), ($\bar{1}$82), and ($\bar{3}$41). Analyses: No. 1, Hiortdahl (85); No. 2, Bodewig and vom Rath (85).

	B_2O_3	CaO	Al_2O_3	Fe_2O_3	MgO	SiO_2	H_2O
1.	47.64	27.97	0.19		0.13	1.28	22.79
2.	49.70	27.42	---	---	---	---	22.26 = 99.38%

Ventura County: Deposits of colemanite, similar to those at Lang, in Los Angeles County, occur on Frazier Mountain, Gale (14c).

Additional references to the literature on colemanite: Arzruni (84), Baumhauer (99), Campbell (02), (03), Evans (84), (85), Foshag (21), Gale (13), Mülheims (88).

MEYERHOFFERITE

Hydrous calcium borate, $Ca_2B_6O_{11}.7H_2O$.

Triclinic. Long prismatic crystals, sometimes tabular parallel to the macropinacoid. Fibrous. Cleavage brachypinacoidal. Vitreous luster. Colorless to white. H. = 2. G. = 2.12.

Fuses readily with intumescence to an opaque white enamel, giving the green flame of boron. Gives water in a closed tube. Easily soluble in acids.

Inyo County: Meyerhofferite occurs as an alteration of the glassy inyoite crystals in the colemanite deposit of the Mount Blanco district on Furnace Creek. It was described, analyzed and named by Schaller (16). Forms: (100), (010), (001), (110), (210), (120), (370), (350), (450), (520), (310), (510), (810), (3$\bar{5}$0), (1$\bar{1}$0), (4$\bar{3}$0), (3$\bar{1}$0), (101), (12.0.11), (706), (605), (504), (705), (302), (12.0.1), ($\bar{1}$01), (111). Analysis:

CaO	B_2O_3	H_2O under 110°	H_2O ab. 110°	
25.45	46.40	1.01	27,75	= 100.61%

INYOITE

Hydrous calcium borate, $Ca_2B_6O_{11}.13H_2O$.

Monoclinic. In large glassy transparent crystals. Cleavage basal. Brittle. H. = 2. G. = 1.875.

Decrepitates on fusing and intumesces, giving the green boron flame. Easily soluble in acids. Gives water in a closed tube.

Inyoite is a borate from the colemanite deposits of the Death Valley region. It was described and named for Inyo County by Schaller (16).

Inyo County: Inyoite occurs in the Mount Blanco district on Furnace Creek associated with colemanite and its alteration product, meyerhofferite.

Forms: (001), (010), (110), and (111). Crystals tabular parallel to base. Analysis:

CaO	B_2O_3	H_2O under 110°	H_2O ab. 110°
20.5	[37.2]	26.1	16.2 = 100.00%

PRICEITE—Pandermite

Hydrous calcium borate, $Ca_5B_{12}O_{23}.9H_2O$.

Triclinic. Massive, chalky. Cleavage (001) perfect. Color snow-white. H. = 3 — 3½. G. = 2.43.

Easily fusible and gives green flame. Soluble in dilute hydrochloric acid. Gives water in a closed tube.

Inyo County: Priceite occurs as nodules and irregular masses in soft gray shale in the Furnace Creek wash. Analysis by Foshag (24b) gave:

SiO_2	CaO	Al_2O_3	B_2O_3	H_2O —	H_2O +	
0.58	32.20	0.20	49.03	0.38	17.86 = 100.25%	G. = 2.43.

KERNITE

Hydrous sodium borate, $Na_2B_4O_7.4H_2O$.

Monoclinic. Cleavage (001), (100) perfect; (101) distinct. Vitreous to pearly luster. Colorless to white. Transparent. H. = 3. G. = 1.953.

Fuses with swelling to a clear glass. Slowly soluble in cold water.

Kern County: Kernite was described by Schaller (27) as a new mineral from the Kramer district, where it is the principal constituent of the borate deposits. Locally called '*rasorite.*' Analysis by Schaller gave:

Na_2O	CaO	B_2O_3	H_2O	Insol.
22.63	0	50.76	26.50	0 = 99.89%

TINCALCONITE—Mohavite

Hydrous sodium borate, $Na_2B_4O_7.5H_2O$.

Hexagonal-rhombohedral. Fine-grained crystalline powder. Dull white. Soft. G. = 1.88.

The name tincalconite was given by Shepard (78) to a pulverulent and efflorescent sodium borate from California containing 32 per cent of water.

Kern County: Tincalconite occurs as a coating on borax and kernite in the Kramer district. Analysis by Schaller (30):

Na_2O	B_2O_3	H_2O	Insol.
21.28	47.26	30.78	0.37 = 99.69%

BORAX

Hydrous sodium borate, $Na_2B_4O_7.10H_2O$.

Monoclinic. Crystals prismatic. Powder, incrustations. Cleavage (100) perfect. Vitreous to dull luster. Colorless, white, grayish, bluish. Streak white. H. = 2 — 2½. G. = 1.69 — 1.72.

Fuses with strong yellow flame to a clear glass. Turmeric paper dipped in a hydrochloric acid solution, turns deep red on drying. Soluble in water. Gives much water in a closed tube. Sweetish alkaline taste.

The natural borax, usually accompanied by sulphates of lime and soda, is common at many of the depressions or sinks of the deserts.

Inyo County: The mines on Furnace Creek and at Resting Springs produced large quantities of borax which were hauled to Mojave by the famous 20-mule teams.

Kern County: Borax has been obtained from Kane Springs and Desert Wells. It occurs with kernite and colemanite in the Kramer district, Schaller (30).

Lake County: The first discovery of borax in the State was made at Borax Lake, near Clear Lake, Veatch (67). Fine large crystals were obtained from the mud of the lake bottom, and considerable borax was dredged from this lake before the more important deposits of San Bernardino County were found, Hanks (83), Vonsen and Hanna (36).

Riverside County: Incrustations of borax are rather common at some of the playas or dry lakes of this county, but none is produced.

San Bernardino County: The most important deposit of borax in the State occurs at Searles Lake in the northern part of the county. Hanks (89) and others have described this deposit. It consists of a pan-like depression about 10 miles long by 5 miles wide; borax occurs with numerous other salts deposited by the evaporated waters of the lake. The associated minerals forming layers in the deposit are principally sulphates and carbonates of sodium, and it is now mainly for these and for the potash associated with them that the deposit is worked. This locality is noted for the great variety of interesting salts that have formed by the evaporation of the waters. Borax has been found with colemanite near Yermo, and at many of the numerous depressions in the Mojave Desert and in the lower end of Death Valley.

PROBERTITE—Kramerite

Hydrous sodium and calcium borate, $NaCaB_5O_9.5H_2O$.

Monoclinic. In radial glassy aggregates. Perfect prismatic cleavage. Brittle. Vitreous luster. Colorless. H. = 2½ — 3½. G. = 2.14.

Easily fusible. Decrepitates and yields water in a closed tube. Soluble in acids; slightly soluble in water.

Inyo County: Probertite occurs with colemanite and ulexite in the Widow and Upper Biddy McCarthy mines near Ryan. Analysis by Foshag (31a).

CaO	MgO	$(Fe,Al)_2O_3$	Na_2O	B_2O_3	H_2O	Insol.	
15.88	0.06	0.38	9.00	49.10	25.64	0.20 = 100.26%.	G. = 2.135.

Kern County: Probertite was described by Eakle (29) as a new mineral from the Kramer district where it occurs in clay with borax and kernite. Schaller (30) reported the crystal forms (100), (110), (101), (111), (010), (011), ($\bar{1}$01), and ($\bar{1}$11). Analysis by Schaller gave:

Na_2O	CaO	B_2O_3*	H_2O	
8.12	15.42	50.73	25.73 = 100.00%	G. = 2.141.

* By difference.

ULEXITE

Hydrous sodium and calcium borate, $NaCaB_5O_9.8H_2O$.

Monoclinic. Usually in nodules or compact fibrous masses. Silky luster. Color white. H. = 1. G. = 1.65.

Fuses with strong yellow flame to a clear glass. Turmeric paper immersed in a hydrochloric acid solution of ulexite becomes red on drying. Calcium can be determined as the oxalate by precipitation from a very weak hydrochloric acid solution. Gives much water in a closed tube. Soluble in acids; slightly soluble in water.

The white silky balls of ulexite are frequently found at some of the desert depressions, often with borax.

Inyo County: Ulexite masses are found at some of the sinks in Death Valley. Ulexite occurs in large compact masses with colemanite at Mount Blanco, Foshag (24). Ulexite occurs in great abundance with colemanite and probertite in the Widow and Biddy McCarthy mines near Ryan, Foshag (31a).

Kern County: Ulexite was mentioned from the Cane Spring district by Silliman (73b). It is found in quantity in the bed of an extensive salt marsh a few miles north of Desert Wells, W. P. Blake (81). It occurs abundantly as compact fibrous veins in clay shale in the Kramer district. Analysis by Schaller (30) gave:

CaO	Na_2O	B_2O_3	H_2O	Insol.
14.06	7.09	42.94	35.54	0.10 = 99.73%

Los Angeles County: Ulexite is found in compact divergent masses with colemanite at Lang. A partial analysis by Foshag (18), (21) gave:

B_2O_3	CaO	H_2O	Na_2O
43.13	14.14	35.68	(7.05) by diff. = 100%

San Bernardino County: Small amounts of ulexite occur with colemanite at Borate, near Yermo.

HYDROBORACITE

Hydrous calcium and magnesium borate, $CaMgB_6O_{11}.6H_2O$.

Monoclinic. Crystals prismatic. In fibrous masses. Cleavages: (100), (010) perfect. Color white. H. = 2. G. = 2.

Fuses easily to a clear glass and colors the flame green. Gives much water in a closed tube.

Inyo County: Foshag (24a) reports that hydroboracite has been found with the borates of the Mount Blanco district. It occurs with colemanite in prismatic or needlelike crystals near Ryan. Schaller (28) found sixteen forms on these crystals, (010), (100), (001), (130), (120), (110), (310), (410), (810), (011), (012), (102), (111), (112), (343), and ($\bar{2}11$). Analysis by Schaller (28).

CaO	MgO	B_2O_3	H_2O	Fe_2O_3	SiO_2	CO_2
14.06	10.14	47.71	27.37	0.12	0.23	tr. = 99.63%

San Bernardino County: Hydroboracite was found in subordinate amounts with colemanite near Yermo.

Ventura County: Hydroboracite is reported to occur at the colemanite mines of Frazier Mountain.

TEEPLEITE

Hydrous sodium borate and chloride, $Na_2B_2O_4.Na_2Cl_2.4H_2O$.

Tetragonal. Tabular crystals. Colorless to light buff. Very brittle. No cleavage. H. = 3.G. = 2.076.

Fuses easily. Yields water in closed tube. Soluble in water.

Lake County: Teepleite occurs with trona and halite in Borax Lake, near Clear Lake. It was found and named by W. A. Gale and M. Vonsen, according to Palache and Foshag (38).

NITRATES

Soda Niter Niter Nitrocalcite Darapskite

Nitrates can exist in solid form only in arid regions, and are therefore peculiar to desert lands where they are sometimes left as white incrustations by evaporation. Some of these white crusts may be found in the California desert land, but no important deposits are known, Mansfield and Boardman (32).

SODA NITER—Chili Saltpeter

Sodium nitrate, $NaNO_3$.

Hexagonal-rhombohedral. Crystals, massive, incrustations. Cleavage perfect rhombohedral. Vitreous luster. Color white, reddish, grayish yellowish. H. = 1½ — 2. G. = 2.24 — 2.29.

Fuses with strong yellow flame of sodium. Heated in a bulb tube with potassium bisulphate, gives off red vapors of nitrous oxide. Soluble in water. Taste cooling.

Inyo County: Crusts containing soda niter and niter occurring along the Amargosa River and along shore lines and old beaches of Death Valley, were reported by Bailey (02). Crusts of soda niter and niter occur near Shoshone. The Confidence, Upper Canyon, Zabriskie, Ratliff claims, and Furnace Creek nitrate fields contain small amounts of soda niter, Noble (31).

Merced County: It occurs in crusts with other sodium salts, from Merced Bottom.

San Bernardino County: White incrustations containing soda niter and niter occur along the Amargosa River. Small amounts of soda niter have been found in the Calico district, A. Williams (83), and at Searles Lake. The Lower Canyon, Saratoga, Upper Canyon, Barstow syncline, Coolgardie Lake, Pilot, Leach Lake, Owl Spring, Twenty-nine Palms, West Well, Beal, Vivet Eye, Vidal, and Danby Lake nitrate fields contain small amounts of soda niter, Noble (31).

Tulare County: Alkaline crusts containing soda niter with other soda salts occur in the San Joaquin Valley, near Tulare.

NITER—Saltpeter

Potassium nitrate, KNO_3.

Orthorhombic. In silky tufts, incrustations. Cleavage (011) perfect, (010) and (100) distinct. Vitreous luster. Colorless. H. = 2. G. = 2.1.

Similar to soda niter in its reactions, but the flame is violet red, best seen through blue glass or the Merwin color screen. Salt taste.

Imperial County: Niter occurs along the former high levels of the Salton Sea in T. 10 S., R. 14 E., S. B. M., Bailey (02).

Inyo County: Niter occurs with soda niter in the Death Valley region. Crusts of niter and soda niter occur near Shoshone. The Confidence, Upper Canyon, Zabriskie, Ratliff claims, and Furnace Creek nitrate fields contain small amounts of niter, Noble (31).

Modoc County: Incrustations of niter have been found near Cedarville.

Riverside County: Bailey (02) mentions saltpeter as occurring in the desert northeast of Salton.

San Bernardino County: It occurs with soda niter along the Amargosa River. The Lower Canyon, Saratoga, Upper Canyon, Barstow syncline, Coolgardie Lake, Pilot, Leach Lake, Owl Spring, Twenty-nine Palms, West Well, Beal, Vivet Eye, Vidal, and Danby Lake nitrate fields contain small amounts of niter, Noble (31).

NITROCALCITE

Hydrous calcium nitrate, $Ca(NO_3)_2.nH_2O$.

In silky tufts and masses. Efflorescent. One perfect cleavage. Colorless. Soft.

Fused with potassium sulphate in a bulb tube, it gives off red fumes of nitrous oxide. Heated in a closed tube, it yields water. Soluble in water. Sharp, bitter taste. Ammonia and ammonium oxalate precipitate white calcium oxalate.

San Bernardino County: Nitrocalcite occurs in the niter beds of the lower end of Death Valley, according to Bailey (02).

DARAPSKITE

Hydrous sodium nitrate and sulphate, $NaNO_3.Na_2SO_4.H_2O$.

Monoclinic. Square tabular crystals. Cleavages (100), (010) perfect. Colorless. $H. = 2 - 3$. $G. = 2.2$.

Fuses with strong yellow flame. Heated in a bulb tube with potassium sulphate, it gives off red nitrous fumes. Barium chloride added to acid solution precipitates barium sulphate. Soluble in water. Yields water in a closed tube.

San Bernardino County: Darapskite occurs in the niter beds of Death Valley, according to Bailey (02).

SULPHATES

Anhydrous sulphates	*Hydrous sulphates*	
Mascagnite	Mirabilite	Halotrichite
Thenardite	Gypsum	Coquimbite
Aphthitalite	Epsomite	Alunogen
Arcanite	Goslarite	Krausite
Glauberite	Morenosite	Voltaite
Barite	Melanterite	Metavoltine
Celestite	Pisanite	Rőmerite
Anglesite	Bieberite	Copiapite
Anhydrite	Boothite	Knoxvillite
	Chalcanthite	Castanite
Sulphates with other acid constituents	Blődite	Fibroferrite
	Boussingaultite	Redingtonite
Burkeite	Potash Alum	Botryogen
Leadhillite	Tschermigite	Alunite
Schairerite	Mendozite	Jarosite
Sulphohalite	Pickeringite	Uraconite
Hanksite		

Basic sulphates

Brochantite	Caledonite	Linarite

ANHYDROUS SULPHATES

MASCAGNITE

Ammonium sulphate, $(NH_4)_2SO_4$.

Orthorhombic. Usually in crusts and stalactitic forms. Cleavage (001) distinct. Vitreous to dull luster. Colorless, yellowish, greenish. H. = 2. G. = 1.76.

Very easily fusible. Soluble in water. Barium chloride added to the solution precipitates barium sulphate. Boiled in a test tube with potassium bisulphate, it gives off the odor of ammonia.

Sonoma County: Goldsmith (76) reported finding mascagnite with boussingaultite in this county.

THENARDITE

Sodium sulphate, Na_2SO_4.

Orthorhombic. Pyramidal, short prismatic or tabular crystals. Basal cleavage. Vitreous. White to brownish. H. = 3. G. = 2.68.

Fuses easily. Soluble in water. Barium chloride precipitates barium sulphate.

Imperial County: A large deposit of thenardite occurs about 2½ miles northeast of Bertram in the Salton Sink.

Inyo County: White masses of thenardite occur in the Funeral Range and in the dry depressions of Death Valley. Large crystals,

some twinned, occur at Deep Springs Valley. The crystals are blue-gray, having the forms (001), and (110); some in cruciform twins.

Kern County: Thenardite collected by D. G. Thompson from near Buckhorn Springs, 6 miles south of Muroc was analyzed by Wells (37).

Insol.	K_2SO_4	NaCl	$NaHCO_3$	Na_2CO_3	H_2O	Na_2SO_4
0.2	0.3	0.2	0.6	1.5	0.3	96.9 = 100%

San Bernardino County: Thenardite forms layers several feet thick at Searles Lake. Large crystals of it often occur as cruciform twins. The crystals were described by Ayers (89). Forms: (110), (001), (111), (106), and (100).

San Luis Obispo County: Soda Lake on the Carrizo Plain, a depression between the Caliente and Temblor Ranges, is a dry lake with crusts of thenardite, Arnold and Johnson (09). Analysis of this crust by Steiger gave:

Insol.	Al_2O_3	MgO	CaO	Na_2O	K_2O	H_2O	SO_3
0.40	0.04	1.66	0.45	40.50	0.28	3.65	46.12

Cl	O = Cl
9.27 = 102.37	— 2.09 = 100.28%

APHTHITALITE—Glaserite

Sulphate of potassium and sodium, $(K,Na)_2SO_4$.

Hexagonal-rhombohedral. Tabular crystals; massive and in crusts. Prismatic cleavage. Brittle. Vitreous luster. Color white. H. = 3. G. = 2.7.

Fuses with yellow flame which shows violet through blue glass. Soluble in water. Barium chloride precipitates barium sulphate.

San Bernardino County: Aphthitalite occurs at Searles Lake. It was obtained from well G 75 in colorless crystals associated with halite on a mass of borax. The forms (0001) and $(10\bar{1}1)$ were noted. The mineral was analyzed and its occurrence described by Foshag (20b).

K	Na	SO_4	Cl	H_2O
32.46	9.01	53.71	4.76	0.10 = 100.04%

This is equivalent to K_2SO_4 72.37%; Na_2SO_4 18.38%; NaCl 7.87%.

ARCANITE

Potassium sulphate, K_2SO_4.

Orthorhombic. Thin basal plates. Vitreous luster. Colorless, yellowish. H. = 2. G. = 2.66.

Like thenardite in its reactions, except that the flame is violet.

Orange County: Arcanite was found as thin crystals on a mine-timber in Tunnel No. 1 of the Santa Ana Tin Mining Company in Trabuco Canyon. The crystals are twinned on the prism and have the forms: (001), (111), (112), and (102), Eakle (08).

GLAUBERITE

Sulphate of sodium and calcium, $Na_2SO_4.CaSO_4$.

Monoclinic. Tabular crystals. Cleavage perfect basal. Brittle. Vitreous luster. Color yellowish-white, gray. Streak white. H. = 2½ — 3. G. = 2.7 — 2.85.

Fuses easily, coloring the flame yellow. Partly soluble in water and completely soluble in dilute acid.

Inyo County: Crystals of glauberite occur in clay seams in the salt crust at Plutos Salt Wells in Death Valley.

Lake County: Glauberite was reported by Silliman (68a) to occur in blue clay at 'Borax Lake,' with no further comment on the locality. According to Vonsen (35) this refers to Borax Lake near Clear Lake in Lake County, where glauberite is known to occur with trona and borax.

San Bernardino County: Glauberite is a prominent mineral in the deposit at Searles Lake. It is found in platy crystals with the forms: (001), (111), vom Rath (87).

BARITE—Heavy Spar

Barium sulphate, $BaSO_4$.

Orthorhombic. Tabular and prismatic crystals, massive, lamellar, granular, concretionary. Cleavage perfect basal and good prismatic. Brittle. Vitreous luster. Color white, yellow, brown. Streak white. H. =2½ — 3½. G. = 4.3 — 4.6.

Fuses with decrepitation and colors the flame green. Fused with sodium carbonate and the fused mass leached with boiling water, gives the sulphate in solution, which can be tested with barium chloride, and leaves the precipitate as barium carbonate, which can be tested for barium. Insoluble in acids.

Barite is commonly found as a gangue mineral in vein deposits, especially in silver-lead districts.

Alpine County: Barite was found with pyrite and enargite at the Morning Star mine.

Butte County: It occurred with gold at the Pinkstown ledge, Big Bend Mountain, Turner (94a).

Calaveras County: It occurs on Carson Hill with quartz and gold; with pyrite at Copperopolis and at Campo Seco.

El Dorado County: Yellow platy barite occurs on Slate Mountain and 10 miles above Georgetown.

Fresno County: Nodules and large concretions of dark-gray impure barite occur in the Mount Diablo Range.

Humboldt County: Veins of white crystalline barite occur on Liscom Hill near Arcata, W. W. Bradley (31).

Inyo County: Massive barite occurs near Independence; at the Defiance mine with native sulphur; white, massive at Bishops Creek,

White Mountains; veins in the Alabama Range. Deposits of massive barite occur 20 miles west of Shoshone.

Lake County: Barite has been found near Glenbrook.

Los Angeles County: Barite was a gangue mineral in the old Kelsey mine, San Gabriel Canyon, Storms (93). Veins of barite occur on the west side of San Dimas Canyon, 8 miles west of San Dimas, W. W. Bradley (31). Barite is the principal gangue mineral at the Renton, Quarry, and Blackjack mines at the east end of Santa Catalina Island, Gieser (27). Small tabular crystals of barite occur with fluorite and galena at the Felix Fluorite mine near Azusa. Crystals of barite are found in the sea cliffs at the Palos Verdes Estates.

Mariposa County: Barite occurs in the Fitch mine with triboluminescent sphalerite, Eakle (04), Eakle and Sharwood (04). A large deposit of barite with witherite about 2 miles west of El Portal has yielded much of the barite mined in California, Fitch (31). Large veins of barite with witherite occur in Devils Gulch, Secs. 17 and 20, T. 4 S., R. 20 E., M. D. M.

Mono County: Barite has been found as a gangue mineral near Bodie and Benton. Barite has been found in the Mono Lake district. It occurs with andalusite in the mine of Champion Sillimanite, Incorporated, on the western slope of the White Mountains, 7 miles east of Mocalno.

Monterey County: A deposit of barite occurs on Fremont Peak.

Napa County: Plates of barite with cinnabar occur at the Manhattan mine, Knoxville; platy quartz as pseudomorphs after barite is also common at this mine. Barite occurs with cinnabar at the Oat Hill mine.

Nevada County: Barite occurs with gold at the Malakoff mine, North Bloomfield. Slender prisms of barite in a limonite gangue associated with gold occur at Pine Hill, and these crystals have been described by Eakle (07). Forms: (100), (010), (110), (210), (320), (530), (130), (001), (102), (011), (111), and (113). A large deposit of white barite occurs 5 miles north of Alta. There is also a large deposit at the Democrat Barytes mine, varying from gray to black in color (due to carbonaceous matter). This material is shipped commercially. Round concretions of barite have been found at the Buckeye Hill mine White veins of barite occur near Graniteville. A large deposit of barite occurs 5 miles northeast of Washington.

Orange County: It occurs with cinnabar about 2 miles east of Tustin, W. W. Bradley (31).

Placer County: White barite comes from near Lincoln.

Plumas County: It is associated with lead and copper minerals in Indian Valley. Small veins of barite occur in altered andesite at the Indian Valley Silver mine. Several large lenses of barite occur in slate in Sec. 5, T. 26 N., R. 8 E., M. D. M., and Sec. 32, T. 27 N., R. 8 E., M. D. M., about 5 miles from Almanor.

Riverside County: It occurs at the Cajalco tin mine near Corona, West (28).

San Benito County: Pure white barite occurs in limestone on the Bardin ranch, Fremont Peak. A barite nodule from about 7½ miles west of New Idria has been analyzed by Steiger, Clarke (15).

BaO	SO_3	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	
57.19	29.41	7.51	2.92	0.41	0.35	0.46	tr.	=98.25%

San Bernardino County: Barite was common as a gangue in the silver districts of Calico and Barstow, occurring as white and yellow platy masses, Lindgren (87), Storms (93). It was common at the Imperial mine. It occurs 6 miles north of Barstow in limestone. White barite has been found near Trona. It was found at Randsburg. Minute crystals of barite showing the forms (001), (110), (011), (102), and (111) have been found in clay near Barstow, Howard (32). Veins of barite occur 1½ miles northwest of Ludlow: Hewett, Callaghan, Moore, Nolan, Ruby and Schaller (36).

San Diego County: It occurs on Red Mountain.

San Francisco County: Needles of barite have been found at Fort Point.

San Luis Obispo County: A deposit of barite is reported on the Fugler ranch, 6 miles southeast of Arroyo Grande, Franke (35). Rosettes of sand barite crystals occur in limy sandstone in the Cuyama Valley.

Santa Barbara County: White massive barite occurs at Santa Maria, and on the North Fork of La Brea Creek, 20 miles from Sisquoc. A wide white vein of barite in sandstone occurs on the ridge above the North Fork of La Brea Creek.

Santa Clara County: Barite occurred in small amounts with ganophyllite in the manganese boulder found near Alum Rock Park, 5 miles east of San Jose. Crystals had the forms: (110), (111), and (001), Rogers (19a). It occurs as veins in an old cinnabar mine on Llagas Creek, 8 miles from Gilroy. It is found as coarsely crystallized masses in the Solis district. Massive barite has been found on Permanente Creek.

Shasta County: Barite occurs at the Bully Hill mine as a gangue mineral. A large deposit of white massive barite occurs 2½ miles north

of Baird. Large deposits of it occur near Copper City and near Castella.

Siskiyou County: It was found with argentiferous galena about 2½ miles north of Callahan.

Trinity County: Dark-gray barite occurs about 15 miles below Hayfork. Small tabular crystals occur in the gold ores of the Five Pines mine associated with pink calcite, and also at the Delta mine, Weaverville Quadrangle.

Tulare County: Deposits of barite occur on the Bauman ranch, 15 miles east of Exeter, at the Paso-Baryta Mines, Ltd., deposit, in the southeastern part of the county near the crest of the Sierra Nevada and on the upper Kern River, near Rattlesnake Creek, Franke (30a).

CELESTITE

Strontium sulphate, $SrSO_4$.

Orthorhombic. Crystals commonly tabular or prismatic; also fibrous and radiated. Cleavage perfect basal. Vitreous luster. Colorless, pale bluish. Streak white. H. = 3 — 3½. G. = 3.95 — 3.97.

Similar to barite in its reactions, except that the flame is deep carmine red. Insoluble in acids.

Imperial County: Beds of massive white celestite occur with gypsum in Sec. 18, T. 13 S., R. 9 E., S. B. M., in the Fish Mountains about 26 miles north of Plaster City, B. N. Moore (35).

Inyo County: Slender bluish crystals occur with the colemanite of Death Valley and have been measured by Eakle (08). Forms: (001), (110), (102), (104), (011), (122), and (067).

San Bernardino County: Long crystals similar to those from Death Valley occur with the colemanite of Calico. Celestite was reported from Searles Lake by Hanks (89). Celestite is associated with strontianite in the Strontium Hills, 10 miles north of Barstow, Knopf (18). Celestite occurs in bedded deposits on the northeast margin of the Avawatz Mountains near the south end of Death Valley, Phalen (14). It occurs interbedded with tuff and clay in Secs. 19 and 20, T. 8 N., R. 7 E., S. B. M., on the southern slope of the Cady Mountains about 3 miles northwest of Argos Station, B. N. Moore (35).

ANGLESITE

Lead sulphate, $PbSO_4$.

Orthorhombic. Prismatic and tabular crystals; massive, granular to compact. Brittle. Adamantine luster. Color white, yellow, gray, green. Streaks uncolored. H. = 2½ — 3. G. = 6.3 — 6.39.

Easily soluble. Can be reduced on charcoal with soda to metallic lead. Slightly soluble in nitric acid.

Anglesite is a common oxidation product of galena, and is often found in lead districts in small amounts.

Inyo County: Considerable anglesite has been formed from the lead sulphides in the Cerro Gordo district, Silliman (73b). It was found with bindheimite, galena, and linarite at the Modoc mine; gray masses banded with cerusite occur at the Cerro Gordo mine. Good crystals associated with linarite and caledonite have come from this mine, with the forms: (001), (100), (110), (104), (111), (122), and (011), Eakle (08). Crystals with the forms: (001), (102), (011), (112), (111), (122), (324), (110), (120), and (010) were described by Guild (11). It was associated with cerusite and galena in limestone at the Ubehebe mine.

Kern County: Anglesite as an oxidation product of lead sulphide occurs 7 miles northwest of Randsburg.

Madera County: It occurs with galena in the Minaret district, Erwin (34).

Mono County: Anglesite occurs in the Blind Spring Hill district.

Riverside County: Anglesite has been identified at the Crestmore quarry, Eakle (17).

San Bernardino County: It occurred massive and in crystals at the Ibex mine, Black Mountains. It was reported by Weeks (25) to occur with galena and cerusite in the Calico mining district.

ANHYDRITE

Anhydrous calcium sulphate, $CaSO_4$.

Orthorhombic. Crystals thick tabular, also prismatic. Usually massive, lamellar, granular. Three perfect pinacoidal cleavages. Brittle. Luster vitreous to pearly. Color white, sometimes with a grayish, bluish, or reddish tinge; also brick-red. Streak grayish-white. $H. = 3 - 3\frac{1}{2}$. $G. = 2.89 - 2.98$.

B. B. fuses at 3, coloring the flame reddish-yellow, and yielding an enamel-like bead which reacts alkaline. Soluble in hydrochloric acid.

Inyo County: Massive anhydrite occurs at the St. Ignacio and Cerro Gordo mines; also in the Panamint and Funeral Ranges.

Mono County: It was found with barite at the Mammoth mine, Mineral Hill.

Orange County: It was found in the Santa Ana Mountains, near Anaheim, Hanks (84).

Riverside County: In the Palen Mountains anhydrite is interlayered with crystalline gypsum in beds alternating with layers of limestone, Rogers (15). Massive anhydrite occurs with gypsum in the Midland mine of the U. S. Gypsum Company in the Little Maria Mountains.

San Bernardino County: Anhydrite is mentioned as one of the associated minerals at Searles Lake, Hanks (89). Deposits with gyp-

sum occur on the Owl Mountains, near Owl Springs, and on the Avawatz Mountains. It occurs with krausite and other sulphates near Borate, about 6 miles northeast of Yermo, Foshag (31b).

Shasta County: Anhydrite partly altered to gypsum occurs at the deep levels of Bully Hill and Rising Star mines, Rogers (15).

SULPHATES WITH OTHER ACID CONSTITUENTS

BURKEITE

$2Na_2SO_4.Na_2CO_3$.

Orthorhombic. Tabular crystals, twins. No cleavage. Brittle. Luster vitreous. Colorless. H. = 3½. G. = 2.57.

Easily fusible. Soluble in water.

San Bernardino County: Burkeite, found with trona and gaylussite at Searles Lake in beds penetrated by drill holes at a depth of 115 to 130 feet, was described and named by Foshag (35).

Na_2O	K_2O	SO_2	CO_2	Cl	H_2O	Insol.
47.89	none	39.96	11.72	0.09	0.04	0.04 = 99.74%

LEADHILLITE

Hydrous carbonato-sulphate of lead, $4PbO.SO_3.2CO_2.H_2O$.

Monoclinic. Tabular crystals. Cleavage perfect basal. Vitreous to pearly luster. Color white, yellowish, greenish. Streak uncolored. H. = 2½. G. = 6.26 — 6.44.

Easily reduced on charcoal to metallic lead, giving a yellow coating. Effervesces briskly in nitric acid. Barium chloride precipitates, from the acid solution, barium sulphate. Gives a small amount of water in a closed tube.

Inyo County: Leadhillite was found as pale sea-green crystals at the Cerro Gordo mine, associated with linarite and caledonite, with the forms: (001), (110), (100), and a prism, Rogers (01).

SCHAIRERITE

$Na_2SO_4.Na(F,Cl)$.

Hexagonal-rhombohedral. Minute crystals. Vitreous. Colorless. H. = 3½. G. = 2.612.

Easily fusible. Soluble in water.

San Bernardino County: Schairerite was discovered in drill samples from Searles Lake. The minute crystals described by Foshag (31) showed the forms (0001), $(10\bar{1}0)$, $(10\bar{1}1)$, and $(01\bar{1}2)$. Analysis:

Ig. loss	Insol.	$(Fe,Al)_2O_3$	CaO	Na	K	SO_4	Cl	F
0.90	0.20	0.15	0.30	35.77	0.13	50.01	3.44	8.08 = 98.98%

SULPHOHALITE

$2Na_2SO_4.NaCl.NaF$.

Isometric. Crystals, mostly octahedrons; rarely dodecahedrons and cubes. Vitreous luster. Color faint greenish-yellow. H. = 3½. G. = 2.43.

Fuses with intumescence, coloring the flame yellow. Soluble in water, and barium chloride precipitates barium sulphate. Silver nitrate precipitates silver chloride.

San Bernardino County: Sulphohalite was found as small crystals implanted on hanksite, at Searles Lake, and was described and named by Hidden and Mackintosh (88), (91). Forms: (111), (101), and (100). Analysis by Penfield (00):

SO_3	Na_2O	K_2O	Na	Cl	F	Ign.
41.79	32.37	0.10	11.60	9.10	4.71	0.15 = 99.82%

Small crystals of sulphohalite as octahedrons were described by Gale and Hicks (14) from Searles Lake. Analysis by Hicks:

SO_3	Na_2O	Na	Cl	F	Loss above 200°C
42.00	32.50	11.35	9.19	[4.17]	0.25

HANKSITE

$9Na_2SO_4.2Na_2CO_3.KCl$.

Hexagonal. Prismatic, tabular. Vitreous luster. Color white. H. = 3 — 3½. G. = 2.562.

Fuses easily, giving a violet flame when seen through blue glass or the Merwin color screen. Easily soluble in water. Taste saline. Shows a slight effervescence when dropped into dilute hydrochloric acid. Barium chloride precipitates barium sulphate.

Inyo County: Hanksite is found with borax in the sinks of Death Valley, Hanks (89).

San Bernardino County: Hanksite was discovered at Searles Lake. It was described and named by Hidden (85), with an analysis by Mackintosh. Forms: (0001), $(10\bar{1}0)$, $(10\bar{1}1)$, and $(20\bar{2}1)$, Hidden; $(40\bar{4}5)$, Dana and Penfield. Analyzed by Penfield, Dana and Penfield (85), and by Pratt (96).

	SO_3	CO_2	Cl	Na_2O	K	Insol.	Ign.
Mackintosh	45.89	5.42	2.36	46.34	---	---	--- = 100.01%
Penfield	43.59	5.42	2.13	40.86	2.33	4.41	1.32 = 100.06%
Pratt	45.93	5.65	2.21	43.35	2.48	0.19	--- = 99.81%
	45.78	5.63	2.28	43.61	2.39	0.12	--- = 99.81%

BASIC SULPHATES

BROCHANTITE

Basic sulphate of copper, $CuSO_4.3Cu(OH)_2$.

Orthorhombic. Small prismatic acicular crystals and drusy crusts. Cleavage perfect brachypinacoidal. Vitreous luster. Color emerald-green, dark-green. Streak pale-green. H. = 3½ — 4. G. = 3.907.

Easily fusible. Reduced on charcoal with sodium carbonate, yields metallic copper. Barium chloride precipitates barium sulphate from a hydrochloric acid solution. Ammonia added to solution gives a blue color. Gives water in a closed tube.

Calaveras County: Brochantite occurred as druses of small dark-green crystals, derived from chalcopyrite, at Copperopolis, Rogers (12).

Inyo County: It occurred as small, dark, emerald-green crystals at the Cerro Gordo mine, with linarite and caledonite. The crystals have the forms: (010), (110), (120), (001), (012), (011), (101), and (041), Eakle (08). It occurs with chrysocolla in the Panamint Mountains near the headwaters of Cottonwood Creek, Ball (07).

Plumas County: Brochantite occurs in crystals at the Engels Copper mine.

San Bernardino County: It was observed as coatings on breccia at Stagg.

CALEDONITE

Basic sulphate of lead and copper, $(Pb,Cu)SO_4.(Pb,Cu)(OH)_2$.

Orthorhombic. Small prismatic crystals. Cleavage perfect basal. Resinous to vitreous luster. Color bluish-green and dark emerald-green. H. = 2½ — 3. G. = 6.4.

Easily fusible. Fused on charcoal with sodium carbonate, it becomes reduced to metallic lead globules and coats the coal yellow near the assay. Barium chloride added to the hydrochloric acid solution precipitates barium sulphate; ammonia added to the solution gives the blue color due to copper. Gives a small amount of water in a closed tube.

Inyo County: Caledonite occurred as small emerald-green crystals with linarite and brochantite at Cerro Gordo. Described by Eakle (08). Forms: (001), (110), (010), (011), (111), (201), (021), (012), (013), (221), (223), (014), and (203). Bright-green crystals from Cerro Gordo described by Guild (11) had the forms: (001), (011), (010), (113), (223), (221), (110), and (201).

Mono County: It was found in the Blind Spring Hill district.

LINARITE

Basic sulphate of lead and copper, $(Pb,Cu)SO_4.(Pb,Cu)(OH)_2$.

Monoclinic. Small crystals, divergent columnar and platy. Cleavage perfect orthopinacoidal. Vitreous to adamantine luster. Color deep azure-blue. Streak pale-blue. H. = 2½. G. = 5.3 — 5.45.

Reactions for linarite are like those for caledonite. The two are often associated, but are easily distinguished by color.

Inyo County: Beautiful divergent, columnar masses of deep azure-blue linarite were obtained in the Cerro Gordo mines during the early days of mining there, the specimens sometimes being banded with green caledonite and brochantite. Fine crystals were also obtained from pockets and cavities in the massive mineral. The Cerro Gordo, Crapo, St. Ignacio, and other mines of the district contained linarite in the oxidized zones of the deposit. Rogers (01) gives several of the forms on the linarite crystals. Forms: (001), (100), (110), (010), $(\bar{2}01)$, and $(\bar{1}01)$. Eakle (08) gives additional forms: (210), (012), (011), $(\bar{2}03)$, $(\bar{1}12)$, $(\bar{2}11)$, $(\bar{7}16)$, $(\overline{14}.0.1)$, $(\bar{3}02)$, and (211). Crystals show twinning on the orthopinacoid.

Madera County: Linarite has been found on the Bliss claims in the Minaret district, Erwin (34).

Mono County: Linarite occurs in the veins of the Blind Spring Hill district.

HYDROUS SULPHATES

MIRABILITE—Glauber Salt

Hydrous sodium sulphate, $Na_2SO_4.10H_2O$.

Monoclinic. Generally as crusts and efflorescences. Cleavage (100) perfect. Vitreous luster. Color white. H. = 1½ — 2. G. = 1.48.

Gives an intense yellow flame when heated. Gives much water in a closed tube. Very soluble in water. Barium chloride precipitates barium sulphate from solution. Taste salt and bitter.

Mirabilite is sometimes found on the walls of mines where sulphide ores are decomposing. It is also found as crusts about dry alkali lakes.

Imperial County: Mirabilite occurs with the thenardite at Pope Siding.

Napa County: It occurred on the walls of the tunnels in the old Redington cinnabar mine, Knoxville.

San Bernardino County: Mirabilite occurs with gypsum and halite in the Chemahuevis Valley about 32 miles south of Needles, Graeff (10).

San Luis Obispo County: It occurs with blödite in the white crystalline salts of Soda Lake, in T. 31 S., R. 20 and 21 E., M. D. M., which receives the drainage of Carrizo Plain, Gale (14b), Franke (35).

GYPSUM

Hydrous calcium sulphate, $CaSO_4.2H_2O$.

Monoclinic. Crystals flattened or prismatic to acicular. Massive, granular, fibrous, lamellar. Cleavage perfect clinopinacoidal. Pearly to subvitreous luster. Colorless, white, gray, light-brown, reddish. Streak white. H. = 1½ — 2. G. = 2.31 — 2.32.

Fuses at 2.5 — 3. Easily soluble in dilute hydrochloric acid. Gives water in a closed tube and crumbles to a white powder.

Gypsum is a very common mineral. Since it is easily formed by the action of sulphate waters on limestone, small amounts of gypsum are common in mining regions where sulphides are decomposing. Larger bodies are generally bedded deposits formed by the evaporation of calcium sulphate waters; these are apt to be impure from admixtures of calcium carbonate and clay.

Selenite, satin spar, alabaster, and *gypsite* are varietal names. The granular, bedded, and efflorescent deposits are the only kind of value in the State and the term 'gypsite' is generally applied to the material of such deposits.

The principal gypsum deposits of the State have been described by Hess (20).

Alpine County: Gypsum occurred in small amounts at Bulliana.

Butte County: It was found at the St. Clair mine. A vein of gray gypsum occurs 1 mile from Pentz, near the road to Cherokee Flat.

Calaveras County: Platy aggregates of gypsum occur with quartz in the Utica mine at Angels Camp, Knopf (29).

Colusa County: Small amounts of it occurred with the sulphur at Sulphur Creek.

Contra Costa County: Selenite is common in the coal seams south of Antioch and near Danville. Disks of selenite occur near Clayton.

Fresno County: Deposits of gypsite occur in the low hills on the north and south sides of Tomey Creek, about 18 miles southwest of Mendota, and along Cantua Creek. In the Coalinga oil district there are frequent occurrences of gypsite. It occurs in the San Joaquin mine, 4 miles northwest of Coalinga, and west of Huron. Satin spar occurs in Oil Creek Canyon.

Imperial County: Yellow selenite has come from about 5 miles west of Volcano. An extensive bed of gypsum associated with celestite occurs in the Fish Creek Mountains. Two samples of gypsum from the Fish Creek Mountains have been analyzed by Fairchild, Wells (37). (a) NE¼SW¼NW¼ Sec. 29, T. 13 S., R. 9 E., S. B. M. (b) SW¼ NE¼SE¼ Sec. 19, T. 13 S., R. 9 E., S. B. M.

	$Al_2O_3Fe_2O_3$	MgO	CaO	H_2O	CO_2	SO_3
(a)	0.18	0.27	32.54	20.00	0.67	44.35 = 98.01%
(b)	None	0.12	32.48	20.44	None	45.42 = 98.46%

Gypsum occurs on the southern slope of the Coyote Mountains, 3 miles northwest of Coyote Wells. High-grade gypsum was found near Dixieland.

Inyo County: Small amounts of gypsum occur in the Cerro Gordo district. Deposits of it occur between Tecopa and Acme. Satin spar occurs in long fibrous masses at Clarks Fork, Amargosa River.

Kern County: Hess (20) reports good deposits of gypsite in the Lost Hills about 25 miles west of Wasco. An analysis of the material was made by R. C. Wells, Hess (20).

CaO	SO_3	H_2O	Cl	Fe_2O_3	CO_2	SiO_2	Al_2O_3	Na_2O	K_2O	MgO
29.5	40.7	19.1	none	0.4	0.7	5.3	1.7	1.2	0.6	--- = 99.2%
29.9	40.8	19.4	none	0.3	---	6.1	1.4	2.0	0.5	--- = 100.4%

Impure gypsite is common in the oil districts, and some has been mined in the McKittrick district. Deposits of it are said to exist on Cottonwood Creek, about 16 miles east of Bakersfield. Beds of gypsum occur in the bed of old Kern Lake, about 20 miles southwest of

Bakersfield and 5 miles from Connor. Gypsite occurs on the shores of Buena Vista Lake. Selenite is found with stibnite at the old San Emigdio antimony mine. Selenite occurs on Poso Creek. Beds of fine-grained, buff-colored gypsite occur about 3½ miles southeast of Cane Springs, Hess (10a).

Kings County: Gypsite occurs in the range of low hills southeast of Dudley, and on Kettleman Plains, about 5 miles northeast of Dudley.

Lake County: Selenite is found on Robinson's ranch. Small amounts of it are found at Sulphur Bank, Clear Lake.

Lassen County: Large slabs of selenite occur near Susanville.

Los Angeles County: Deposits of good white gypsum in shale occur in Charley Canyon, 12 miles north of Castaic. Gypsite and alabaster interbedded with shales occur on a ridge about 1½ miles southwest of Palmdale, Hess (10). Seams of gypsum occur in the bluffs at San Pedro. A deposit of it is reported 2 miles north of Lang. Large selenite plates have been found in Soledad Canyon.

Mariposa County: Selenite has been reported from Bear Valley.

Merced County: Low-grade gypsum is produced in commercial quantities at Dos Palos.

Mono County: It occurs in the Bodie district. It was observed in the mountains south of Mono Lake.

Monterey County: Deposits of it occur east of King City, near the county line.

Napa County: Small amounts of gypsum were associated with cinnabar at the old Redington or Boston mine, Knoxville. Fine crystals of gypsum have been found in the Palisades mine, 2 miles north of Calistoga.

Nevada County: Fibrous radiate gypsum occurs near Truckee.

Orange County: Outcrops of gypsum occur in Gypsum Canyon and adjacent canyons, about 2 miles south of Corona. Alabaster occurs on the San Joaquin ranch.

Riverside County: Selenite occurs south of South Riverside. Deposits of it occur near Banning and in the hills west and southwest of Corona. An important deposit of massive gypsum occurs at the Midland mine of the U. S. Gypsum Company in the Little Maria Mountains. Extensive gypsum deposits occur in the central part of the Palen Mountains, Harder (10c) and in the Maria Mountains 17 miles south of Blythe Junction, Surr (11).

San Benito County: Outcrops of gypsum occur in many places along the Coast Range. There are many occurrences of it in the Bitterwater Valley. Deposits were found east of Metz and King City.

San Bernardino County: A large deposit of impure gypsite occurs at Amboy. Gypsum was found in the lake beds south of Danby and near Kelso. Gypsum occurs with borax at Searles Lake. Large deposits of massive white, pink, and red gypsum occur on the northeast side of the Avawatz Mountains; also selenite and satin spar. Good crystals of selenite occur in the colemanite beds near Yermo. It occurs near Camp Cady. Thin beds of gypsum are associated with rock salt in the Avawatz Mountains. Crystals occur in the mud of the Strontium Hills, 10 miles north of Barstow. Gypsum occurs with krausite and other sulphates in the Calico Hills about 6 miles northeast of Yermo, Foshag (31b).

San Diego County: Gypsite is found near Dos Palmas.

San Francisco County: Small amounts of gypsum have been found near Merced Lake. Disks of selenite occur on Seal Rocks. Selenite is found at Fort Point.

San Joaquin County: Selenite occurs at Vernalis.

San Luis Obispo County: White bunches and veins of gypsum occur on Alamo Creek, 16 miles from Santa Maria. Alabaster occurs at Arroyo Grande. Gypsite occurs in beds on the southwest side of the Temblor Range, east of Carrizo Plain. Selenite crystals occur in the clays of Carrizo Creek.

Santa Barbara County: Alabaster occurs near Santa Barbara Creek, about 32 miles southwest of McKittrick. Small amounts of alabaster are found on Santa Rosa Island. Massive gypsum was worked near Point Sal. Massive gypsum occurs in Cuyama Canyon on the east side of Santa Barbara Canyon, 5 miles south of Quartel.

Santa Clara County: Selenite occurs near Gilroy.

Santa Cruz County: Satin spar and massive white gypsum occur near Santa Cruz.

Shasta County: Gypsum as an hydration product of anhydrite occurs in the Bully Hill and the Rising Star mines.

Sierra County: Small amounts of gypsum have been found on Kanaka Creek.

Siskiyou County: Copious deposits of gypsum occur near the spring at the summit of Mount Shasta, H. Williams (34).

Sonoma County: It was found at The Geysers with sulphur and boussingaultite. Good crystals of selenite have been found near Santa Rosa.

Stanislaus County: Selenite is found near Modesto.

Trinity County: Small amounts of fibrous gypsum occur at Island Mountain.

Tulare County: Fibrous satin spar occurs at White River. Gypsum occurs 20 miles southeast of Porterville.

Tuolumne County: Gypsum has been found near Groveland.

Ventura County: Small amounts of it were found on the Dennison ranch, 3 miles east of Nordhoff. Massive white gypsum occurs 4 miles south of Fillmore interbedded with diatomaceous shale. It occurs on South Mountain about 4 miles south of Santa Paula. Alabaster occurs on French Point Hill, 6 miles above the mouth of Santa Barbara Canyon. Selenite occurs in Lockwood Valley.

EPSOMITE—Epsom Salt

Hydrous magnesium sulphate, $MgSO_4.7H_2O$.

Orthorhombic; disphenoidal. Usually in bunches of long slender fibers and fibrous crusts. Cleavage perfect brachypinacoidal. Vitreous to earthy luster. Color and streak white. H. = 2—2½. G. = 1.75.

Soluble in water. Taste bitter and salt.

Effloresccnses of epsomite are common in caves and tunnels where pyrite or other sulphides are decomposing in the presence of magnesian rocks. Long hair-like masses of epsomite are common in the cinnabar mines of the State. Commercial epsom salt is produced as a by-product in the evaporation of the bitterns of sea water.

Alameda County: Epsomite occurs as efflorescence on the walls of the pyrite mines of Leona Heights. Analyzed from the Alma mine by Schaller (03).

MgO	SO_3	H_2O at 100°	H_2O ab. 110°	Al_2O_3
14.8	31.7	40.8	12.2	tr. = 99.5%

Amador County: It was common in the mines on Copper Hill.

Imperial County: It was mentioned by Emory (48) as occurring in white crusts on the Colorado Desert.

Inyo County: Epsomite occurs with alunogen in clay at the mine of the American Magnesium Company in the Wingate district, near Ballarat.

Lake County: It was abundant in the old Abbott quicksilver mine.

Mariposa County: It was found as fine fibers in the Purchase mine near Donovan.

Napa County: Epsomite was abundant in long white fibers in the tunnels of the old Redington mine, Friedrich (88).

San Benito County: Exceptionally long fibers of epsomite occur in the New Idria cinnabar mine.

Santa Barbara County: Colorless tufts and masses of epsomite have been found in shale at Point Rincon, Arnold and Anderson (07).

Santa Clara County: It is abundant on the walls of the New Almaden and other cinnabar mines of the county.

Sonoma County Epsomite with boussingaultite was reported from the county, Goldsmith (76a).

GOSLARITE

Hydrous zinc sulphate, $ZnSO_4.7H_2O$.

Orthorhombic. In long acicular crystals and massive crusts. Perfect brachypinacoidal cleavage. Brittle. Vitreous luster. Color white, reddish, yellowish. H. = 2. G. = 2.

Reduced with soda on charcoal, gives yellow coating, which turns green when heated with cobalt nitrate. Yields water in closed tube. Easily soluble in water. Taste astringent.

Goslarite is formed through the decomposition of sphalerite and is sometimes found on mine walls.

Trinity County: A very small amount of white powdery goslarite occurs in the decomposed material at the pyrrhotite deposit at Island Mountain.

MORENOSITE

Hydrous nickel sulphate, $NiSO_4.7H_2O$.

Orthorhombic. In acicular crystals; fibrous, as an efflorescence. Cleavage (010), perfect. Vitreous luster. Color apple-green to greenish-white. H. = 2 — 2½. G. = 2.

Fused in a borax bead, gives a brown bead of nickel in the oxidizing flame, which becomes gray and cloudy in the reducing flame. Gives off acid water in a closed tube. Soluble in water giving a metallic taste.

Napa County: Morenosite was said by Becker (88) to coat a specimen of millerite from the Phoenix cinnabar mine.

San Diego County: Morenosite occurs with limonite and erythrite in the oxidized part of the ore in the Friday copper mine, near Julian, Hudson (22).

MELANTERITE—Copperas

Hydrous ferrous sulphate, $FeSO_4.7H_2O$.

Monoclinic. Fibrous, stalactitic, and concretionary; also massive. Cleavage basal. Brittle. Vitreous luster. Color green to white. Streak uncolored. H. = 2. G. = 1.89 — 1.9.

Easily fusible. Becomes magnetic on heating. Easily soluble in water. Gives acid water in a closed tube. Astringent taste.

Melanterite is a common alteration product in mines containing pyrite or marcasite.

Alameda County: Melanterite was abundant as small fibrous crystals on the walls of the Alma pyrite mine at Leona Heights.

Described and analyzed by Schaller (03). Forms: (110), (001), (010), (103), (101), (011), (111), ($\bar{1}$21), (120), (102), (203), (302), (201), (904) and (332).

FeO	SO_3	H_2O	CuO	MgO
28.1	31.2	42.0	none	none = 101.3%

Alpine County: Melanterite occurs in fibrous groups up to 3 inches in length and as glassy incrustations and seams in the Leviathan mine, 3 miles northeast of Loope.

Amador County: It occurred with mendozite on the walls of an old tunnel 1½ miles north of Volcano.

Lake County: Melanterite was abundant as stalactites in the Sulphur Bank cinnabar mine, Clear Lake. It occurred as brilliant green stalactites in the Bedford quicksilver mine, Friedrich (88).

Mariposa County: It was found as coatings in the Purchase mine, near Donovan.

Mono County: Melanterite was common in the mines near Lundy. It is found with pyrite and arsenopyrite near Mono Lake.

Napa County: Long pale-green stalactites of melanterite were abundant in the old Redington cinnabar mine, Knoxville. It was found in the Palisades mines, 2 miles north of Calistoga.

Orange County: Fibrous crusts of melanterite occur on sandstone in the Santiago Coal mine, Santa Ana Mountains.

San Benito County: Botryoidal masses of silky melanterite occur in the New Idria quicksilver mine.

San Bernardino County: Melanterite occurs in the silver mines of the Rand district, Hulin (25).

Santa Cruz County: Specimens of melanterite have come from near Santa Cruz.

Shasta County: It is common at Copper City, and in the Bully Hill and other mines of the county.

Sonoma County: Drusy green melanterite has been found near Petaluma.

Trinity County: It occurs with goslarite at Island Mountain.

PISANITE

Hydrous iron and copper sulphate, $(Fe.Cu)SO_4.7H_2O$

Monoclinic. Long slender prisms, stalactitic. Cleavage (001) easy. Vitreous luster. Color greenish-blue. H. = 2 — 3. G. = 2.15.

Reactions are similar to those for melanterite, except that ammonia turns the solution blue at the same time precipitating the iron as ferric hydroxide.

Alameda County: Pisanite was one of the secondary sulphates formed with melanterite and chalcanthite on the walls of the Alma

pyrite mine on Leona Heights. Described and analyzed by Schaller (03). Forms: (001), (101), (010), (110), (103), (011), (100), (210), (320), (120), $(\bar{1}01)$, $(\bar{1}12)$, (111), $(\bar{3}35)$, $(\bar{2}21)$, and $(\bar{1}21)$.

			H_2O			
CuO	FeO	SO_3	at 110°	ab. 110°	MgO	
15.73	12.31	28.21	45.14		---	= 101.39%
9.22	16.47	29.18	45.74		---	= 100.61%
17.95	5.46	29.25	34.25	10.96	2.82	= 100.69%

Monterey County: Pale-blue crystals of pisanite from near Gonzales were analyzed by Schaller (04).

CuO	FeO	SO_3	H_2O
7.56	15.85	30.74	45.85

Trinity County: It was found with goslarite in the pyrrhotite mass at Island Mountain.

BIEBERITE

Hydrous cobalt sulphate, $CoSO_4.7H_2O$.

Monoclinic. Stalactites and crusts. Vitreous luster. Color flesh and rose-red. H. = 2. G. = 2.

Gives a blue bead with borax. Sulphate is precipitated by barium chloride. Yields water in a closed tube and has an astringent taste.

Trinity County: Small amounts of bieberite occur as a pale rose-red powder, formed by the desiccation of the sulphate solutions at the pyrrhotite deposit near Island Mountain.

BOOTHITE

Hydrous cupric sulphate, $CuSO_4.7H_2O$.

Monoclinic. Fibrous, massive. Vitreous. Greenish-blue. H. = 2 — 2½. G. = 1.94.

Same reactions as for chalcanthite.

Alameda County: Boothite was found with other sulphates of iron and copper at the Alma pyrite mine, Leona Heights. It was described as a new mineral and named by Schaller (03). Forms: (001), (100), (110), $(\bar{1}01)$, $(\bar{3}01)$, $(\bar{1}12)$, $(\bar{1}11)$, and $(\bar{1}21)$.

				H_2O			
CuO	FeO	MgO	SO_3	at 105°	ab. 105°		
27.83	tr.	--	28.37	36.64	7.42	= 100.26%	
28.53	.28	tr.	28.65	43.76		= 101.22%	G. = 1.935

Calaveras County: Crystals of boothite were found at Campo Seco and analyzed by Schaller (04).

				H_2O			
CuO	FeO	MgO	SO_3	at 110°	ab. 110°	Insol.	
26.13	0.81	0.64	27.25	36.76	4.91	3.96 = 100.46%	G. = 1.944.

CHALCANTHITE—Blue Vitriol

Hydrous cupric sulphate, $CuSO_4.5H_2O$.

Triclinic. Crystals commonly flattened. Massive, stalactitic, and fibrous. Brittle. Vitreous luster. Color greenish-blue to sky-blue. Streak uncolored. H. = 2½. G. = 2.12 — 2.30.

Fusible. In a closed tube yields water. Soluble in water. Gives the blue solution of copper when ammonia is added.

Chalcanthite is found in mines where it results from the oxidation of copper sulphides.

Alameda County: Chalcanthite was common in small crystals and seams in the Alma pyrite mine, Leona Heights. It was described and analyzed by Schaller (03). Forms: (001), (010), (100), (110), (120), $(1\bar{1}0)$, $(1\bar{2}0)$, (011), $(0\bar{2}1)$, $(0\bar{3}1)$, $(\bar{1}01)$, $(\bar{1}11)$, $(1\bar{3}1)$, and $(1\bar{4}1)$.

CuO	FeO	MgO	SO_3	H_2O at 110°	H_2O ab. 110°	Insol.
31.14	none	tr.	32.06	28.20	7.50	0.81 = 99.71%

Amador County: It was common in the mines on Copper Hill.

Calaveras County: It occurred at Quail Hill, Silliman (67a). It was common at Copperopolis.

Nevada County: It was found at Sweetland, Hanks (84).

Shasta County: Chalcanthite was a common evaporation product in the mines of the county and was reported from the Peck mine, Copper City, Hanks (84). Bluish-green crystals and veins of it have been observed at Copper City.

Trinity County: Chalcanthite has been found in the mine of the Island Copper Company at Island Mountain.

BLÖDITE

Hydrous magnesium and sodium sulphate, $MgSO_4.Na_2SO_4.4H_2O$.

Monoclinic. Prismatic crystals, granular massive. Vitreous luster. Colorless to greenish, yellowish, red. H. = 3. G. = 2.23.

Fuses, giving a strong yellow flame. Barium chloride precipitates barium sulphate from an acid solution. Magnesia is determined by precipitation with sodium phosphate from an ammonia solution. Easily soluble in water. Gives water in a closed tube.

Imperial County: Blödite was reported to have been found on the Colorado Desert.

San Luis Obispo County: Very large crystals of blödite found in the mud of Soda Lake, Carrizo Plain, have been described by Schaller (13). They show the following forms: (001), (110), (210), (011), (111), $(\bar{2}01)$, $(\bar{1}11)$, $(\bar{2}11)$, and $(\bar{1}21)$. Analysis:

Na_2O	MgO	SO_3	H_2O
18.26	11.93	48.11	21.37 = 99.67%

BOUSSINGAULTITE

Hydrous ammonium and magnesium sulphate, $(NH_4)_2SO_4.MgSO_4.6H_2O$.

Monoclinic. Fibers, crusts, vermiform aggregates and stalactites. Cleavages ($\bar{2}01$) perfect; (010) distinct. Silky luster. Color pure-white. H. = 2. G. = 1.68 — 1.72.

Easily fusible, and easily soluble in water. Barium chloride precipitates barium sulphate, and sodium phosphate precipitates the magnesia. Gives water in a closed tube. Heated in closed tube with lime, it gives odor of ammonia. Taste saline-astringent.

Sonoma County: Boussingaultite from this county was described and analyzed by Goldsmith (76a). No locality was given, but presumably it came from near The Geysers.

SO_3	MgO	NH_4OH	H_2O
38.86	15.56	5.03	40.55

Ventura County: Boussingaultite was found on South Mountain opposite Santa Paula, in stalactites and incrustations, formed by heated gases escaping through crevices in sandstone and shale. It was described by Larsen and Shannon (20). Analysis by Shannon:

$(NH_4)_2O$	MgO	Al_2O_3	Fe_2O_3	K_2O	Na_2O	CaO	SO_3
10.86	11.54	0.04	0.08	0.22	0.60	tr.	43.49

H_2O	Cl	CO_2
31.48	tr.	tr. = 98.31%

POTASH ALUM

Hydrous aluminum and potassium sulphate, $K_2SO_4.Al_2(SO_4)_3.24H_2O$.

Isometric. Mealy crusts and fine fibres. Vitreous luster. Colorless or white. H. = 2. G. = 1.76.

Gives the violet flame of potassium when fused on platinum wire. Ammonia precipitates flocculent aluminum hydroxide, and barium chloride precipitates barium sulphate from solution. Yields much water in a closed tube. Easily soluble in water.

Alpine County: Potash alum was found in the mines of Silver Mountain.

Calaveras County: It was observed at Quail Hill, Silliman (67a).

Contra Costa County: Fine specimens of crystallized potash alum have come from the old coal mine at Nortonville.

Fresno County: It was common with sulphur in the oil district at Coalinga.

Inyo County: Potash alum occurs on the shores of Owens Lake. It occurred as white crusts on the sides of a steaming vent 2 miles east of Coso Springs, Rogers (12). Potash alum occurs with alunite and andalusite at the mine of Champion Sillimanite, Incorporated, on the western slope of the White Mountains, 7 miles east of Mocalno, Woodhouse (36).

Lake County: It was common at the Sulphur Bank cinnabar mine.

Los Angeles County: It occurs near Newhall.

Mono County: It was found near Bodie.

Napa County: Potash alum was observed in the Redington cinnabar mine at Knoxville, Melville and Lindgren (90).

Placer County: It occurred in the gold mines near Dutch Flat; in slates near Auburn.

Sonoma County: It was found at The Geysers.

TSCHERMIGITE—Ammonia Alum

Hydrous aluminum and ammonium sulphate, $(NH_4)_2SO_4.Al_2(SO_4)_3.24H_2O$.

Isometric. Octahedral crystals, fibrous, crusts. Vitreous luster. Colorless or white. H. = 2. G. = 1.64.

Easily fusible. Heated in a closed tube with lime, it gives off odor of ammonia. Gives water in a closed tube. Soluble in water.

Lake County: Tschermigite was mentioned by Becker (88) as an efflorescence at Sulphur Bank.

MENDOZITE

Hydrous aluminum and sodium sulphate, $Na_2SO_4.Al_2(SO_4)_3.22H_2O$.

White fibrous masses or powder. H. = 3. G. = 1.73.

Very easily fusible. Gives strong yellow flame. Soluble in water.

Amador County: Crusts of mendozite and melanterite occur on the walls of an old tunnel 1½ miles north of Volcano.

Napa County: It occurs on the Pritchard ranch, 9 miles southeast of St. Helena.

San Bernardino County: Platy and fibrous, white mendozite occurs 5 miles north of Hidden Springs.

PICKERINGITE—Magnesia Alum

Hydrous aluminum and magnesium sulphate, $MgSO_4.Al_2(SO_4)_3.22H_2O$.

Monoclinic. Fine acicular crystals and as efflorescences. Silky luster. Colorless, white, yellowish, pink. H. = 1. G. = 1.85.

Easily fusible. Soluble in water, giving a bitter, astringent taste. Yields water in a closed tube.

Inyo County: Pickeringite was reported as an efflorescence in the mountains west of Bishop.

San Bernardino County: Pickeringite occurs as a coating on quartzite along the South Fork of Barrett Canyon, a tributary of San Antonio Canyon, Sec. 31, T. 2 N., R. 7 W., S. B. M.

Sonoma County: The name *sonomaite,* no longer recognized as a species, was given by Goldsmith (76) to a mineral from near The Geysers having a composition similar to pickeringite.

Al_2O_3	FeO	MgO	SO_3	H_2O
7.66	2.01	7.14	38.78	44.41
8.36	1.56	7.51	38.30	44.27

HALOTRICHITE—Iron Alum

Hydrous aluminum and iron sulphate, $FeSO_4.Al_2(SO_4)_3.22H_2O$.

Monoclinic. Fibrous. Silky luster. Color yellowish-white. H. = 2. G. = 1.9.

Fusible. Soluble in water. Ink taste. Ammonia precipitates iron and alumina from solution. Barium chloride precipitates barium sulphate. Gives much water in a closed tube.

Alameda County: Halotrichite was found as fibrous masses in the Eureka tunnel near Livermore.

San Bernardino County: Fibrous veins of halotrichite occur with krausite, alunite, coquimbite, and other sulphates in the Calico Hills near Borate, about 6 miles northeast of Yermo, Foshag (31b).

Trinity County: Halotrichite occurs in tufts in shale above the pyrrhotite deposit at Island Mountain.

COQUIMBITE

Hydrous iron sulphate, $Fe_2(SO_4)_3.9H_2O$.

Hexagonal-rhombohedral. Generally granular massive. Vitreous luster. Color white, yellowish, brownish, greenish, violet. H. = 2 — 2½. G. = 2.09.

Fusible. Becomes magnetic on heating. Gives water in closed tube. Soluble in water and has an astringent taste.

Calaveras County: Coquimbite was found at Quail Hill, Silliman (67a).

El Dorado County: It occurred in the shales near Georgetown.

Inyo County: Yellow crystals of coquimbite have been found at Lone Pine.

Napa County: Large masses of yellowish-green, granular coquimbite found at the old Redington cinnabar mine were described by Eakle (01) with analysis by Schaller.

Fe_2O_3	Al_2O_3	SO_3	H_2O at 110°	ign.	FeO	SiO_2	Na_2O	MgO
12.99	7.44	38.04	23.72	13.71	0.13	0.21	1.68	1.09 = 99.01%

San Bernardino County: Coquimbite occurs with krausite and alunite near Borate in the Calico Hills about 6 miles northeast of Yermo, Foshag (31b).

Tuolumne County: Silliman (67a) mentions coquimbite as one of the minerals found at Whiskey Hill.

ALUNOGEN

Hydrous aluminum sulphate, $Al_2(SO_4)_3.16H_2O$.

Monoclinic. Fibrous masses, crusts, powder. Vitreous to silky luster. Color white. H. = 1½ — 2. G. = 1.6 — 1.8.

In a closed tube gives water. Soluble in water and has an alum taste. Ammonia precipitates aluminum hydroxide.

Alameda County: Alunogen occurred as a white powder at the Alma mine, Leona Heights, Schaller (03).

Inyo County: It occurs in fibrous masses with epsomite in clay at the mine of the American Magnesium Company near Ballarat.

Marin County: It was found with gypsum in shale at the road tunnel near Fort Barry.

Nevada County: It was observed at the Providence mine, Nevada City, Lindgren (96).

San Luis Obispo County: Alunogen was found as a white powder near Paso Robles.

KRAUSITE

Hydrous iron and potassium sulphate, $K_2SO_4.Fe_2(SO_4)_3.2H_2O$.

Monoclinic. Rough crystals, often prismatic. Cleavage (001) perfect, (100) good. Brilliant luster. Color lemon-yellow to yellowish-green. H. = $2\frac{1}{2}$. G. = 2.84.

B. B. decrepitates and finally changes to a black scoriaceous mass. Soluble in acid.

San Bernardino County: Krausite occurs with copiapite, alunite, and other sulphates in a lenticular mass in shale near Borate in the Calico Hills, about 6 miles northeast of Yermo. It was discovered, named, and analyzed by Foshag (31b).

CaO	FeO	Fe_2O_3	K_2O	Na_2O	SO_3	SiO_2	H_2O	Insol.
0.12	0.24	24.94	14.71	0.64	51.05	2.19	5.59	0.92 = 100.40%
								G. = 2.840.

Foshag reported the forms (001), (100), (210), (110), $(\bar{1}01)$, $(\bar{1}02)$, $(\bar{2}11)$, and $(\bar{1}12)$ on crystals of krausite.

VOLTAITE

$3(K_2,Fe)O.2(Al,Fe)_2O_3.6SO_3.9H_2O$.

Isometric. In cubic, octahedral, and dodecahedral crystals. Luster resinous. Color dull oil-green to brown or black. Streak grayish-green. H. = 3 — 4. G. = 2.8.

Soluble in water.

San Bernardino County: Voltaite was found by Foshag (31) with krausite, copiapite, coquimbite, and other sulphates in a lenticular mass near Borate, about 6 miles northeast of Yermo.

Shasta County: Anderson (27) observed voltaite with melanterite on some altered pyrite from this county.

METAVOLTINE

$(H,K)_4(FeOH)_2(SO_4)_4.5H_2O$.

Hexagonal. In aggregates of minute yellow scales. H. = $2\frac{1}{2}$. G. = 2.5.

Soluble in acid. Partly soluble in water.

San Bernardino County: Foshag (31b) has found metavoltine with krausite, coquimbite, alunite and other sulphates near Borate in the Calico Hills about 6 miles northeast of Yermo.

RÖMERITE

Hydrous iron sulphate, $FeO.Fe_2O_3.4SO_3.14H_2O$.

Triclinic. In tabular crystals; granular, massive. Perfect brachypinacoidal cleavage. Brittle. Color chestnut-brown. H. = 3 — 3½. G. = 2.15.

Fusible. Becomes magnetic on heating. Easily soluble in water. Taste saline, astringent.

San Bernardino County: Römerite occurs with alunite, coquimbite, krausite, and other sulphates in the Calico Hills near Borate, about 6 miles northeast of Yermo, Foshag (31b).

Trinity County: Small brown crystals of römerite showing the forms (001), (0$\bar{1}$0), (100), (110), (210), (310), (18.5.0), (410), (1$\bar{1}$0), (120), (2$\bar{1}$0), and (4$\bar{1}$0) occurring on altered pyrrhotite from Island Mountain were described by Landon (27). Analysis by Landon:

SO_3	Fe_2O_3	FeO	H_2O
38.30	20.60	6.94	33.40

COPIAPITE

A basic ferric sulphate, perhaps $Fe_4(OH)_2(SO_4)_5.18H_2O$.

Orthorhombic. Crystalline scales, or granular massive; incrustations. Cleavage (001) perfect. Pearly luster. Color sulphur-yellow. H. = 2½. G. = 2.10.

Similar to coquimbite in its reactions.

Alameda County: Copiapite was found as yellow needles at the Alma mine, Leona Heights, and was analyzed by Schaller (03).

SO_3	Al_2O_3	Fe_2O_3	FeO	MgO	H_2O	Insol.
38.36	0.31	25.04	0.44	0.29	29.71	5.43 = 99.58%

Lake County: It occurred at Sulphur Bank and was analyzed by Melville and Lindgren (90).

SO_3	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	H_2O	Insol.
38.82	0.37	26.79	3.28	tr.	0.25	0.16	29.58	0.75 = 100%

Napa County: It was found at the old Redington mine, Knoxville, and was analyzed by Melville and Lindgren (90).

SO_3	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	H_2O
39.97	---	26.54	0.46	0.21	---	3.06	30.43 = 100.67%

Riverside County: Specimens of copiapite with amarantite have been described from the Santa Maria Mountains by Schairer and Lawson (24). Analysis of the copiapite gave:

SO_3	Fe_2O_3	CaO	MgO	H_2O	Insol.
39.79	26.23	0.27	3.19	29.92	0.30 = 99.86%

San Bernardino County: Copiapite occurs with krausite, coquimbite, and alunite in the Calico Hills near Borate, about 6 miles northeast of Yermo, Foshag (31b).

Trinity County: Copiapite occurs with pyrrhotite at the Island Mountain Copper mine.

KNOXVILLITE

Hydrous basic sulphate of iron, chromium, aluminum, nickel, and magnesium.

Orthorhombic. Tabular crystals. Cleavage perfect basal. Vitreous luster. Color greenish-yellow.

Becomes magnetic on heating. May give a chromium bead when fused with borax. Soluble in water. Barium chloride precipitates barium sulphate. Gives water in a closed tube.

Knoxvillite is considered by Larsen (21) to be a variety of copiapite.

Napa County: Greenish-yellow masses of this complex sulphate were found in the old Redington mine, Knoxville, and the mineral was described as new by Melville and Lindgren (90). Forms: (001), (110), and (100). The crystals are basal plates.

SO_3	Fe_2O_3	Cr_2O_3	Al_2O_3	FeO	NiO	MgO
35.91	15.36	7.41	4.83	3.81	0.83	3.22

H_2O at 100°	H_2O ab. 100°	Insol.
9.30	17.60	1.73 = 100.00%

CASTANITE

Basic iron sulphate, $Fe_2O_3.2SO_3.8H_2O$.

Triclinic. Crystalline aggregates, clusters or prismatic crystals. Cleavage (010) perfect, (110) and $(1\bar{1}0)$ less perfect. Luster vitreous. Color orange to dark -brown. H. = 3. G. = 2.2.

Fusible. Heated in a closed tube, turns dark and gives water which has an acid reaction. Practically insoluble in cold water but decomposed by hot water. Easily soluble in hydrochloric acid.

Napa County: Rogers (31c) has described crystals of castanite from the old Redington or Boston quicksilver mine at Knoxville. Forms: (010), $(1\bar{1}0)$, (110), (001), (011), and (112). Analysis by O. C. Shepard.

Fe_2O_3	SO_3	H_2O+	H_2O-	Insol.	
34.47	35.11	14.58	15.73	0.22 = 100.11%	G. = 2.2.

FIBROFERRITE

Hydrous iron sulphate, $Fe_2O_3(SO_3)_2.10H_2O$.

Orthorhombic. Fine fibrous aggregates. Silky luster. Color pale-yellow to white. H. = 2 — 2½. G. = 1.9.

Fusible. Becomes magnetic on heating. Soluble in water.

Napa County: Fibroferrite has been found with cinnabar, opal, sulphur, and sulphates in the Redington mine at Knoxville, Rogers (31c).

San Bernardino County: Fibroferrite occurs with krausite, coquimbite, and other sulphates in the Calico Hills near Borate, 6 miles northeast of Yermo, Foshag (31b).

Trinity County: Fibrous aggregates of yellow fibroferrite occur in the pyrrhotite deposit at Island Mountain.

REDINGTONITE

Hydrous chromium, aluminum, iron, and magnesium sulphate.

Finely fibrous to granular massive. Silky luster. Color pale-purple. G. = 1.76.

Reactions are similar to those for knoxvillite.

Napa County: Redingtonite is a pale-purple sulphate which was mixed with the knoxvillite from the Redington mine at Knoxville. It was described as a new mineral by Melville and Lindgren (90).

SO_3	Al_2O_3	Cr_2O_3	Fe_2O_3	FeO	NiO	MnO	MgO	H_2O at 100°	H_2O ab. 100°	Insol.
35.35	5.14	7.51	0.19	4.58	1.00	tr.	1.85	27.09	14.34	3.46 = 100.51%

G. = 1.761.

BOTRYOGEN

Hydrous iron and magnesium sulphate, $Fe_2O_3.2MgO.4SO_3.15H_2O$.

Monoclinic. Very small crystals. Reniform and botryoidal. Cleavage (010) perfect. Vitreous luster. Color brick-red, hyacinth-red, ocher-yellow. H. = 2 — 2½. G. = 2.04 — 2.14.

Fusible. Becomes magnetic on heating. Presence of magnesia distinguishes it from other iron sulphates. Partly soluble in water. Soluble in acid.

Napa County: Botryogen is found in bunches of small brick-red crystals in one of the tunnels of the old Redington mine, Knoxville. It was thought to be a new mineral and described and named 'palacheite' by Eakle (03). Its identity with botryogen was later established, Eakle (03a). Forms: (110), (010), (001), (120), (450), (021), ($\bar{2}01$), ($\bar{1}11$), ($\bar{1}21$), (100), and (011).

Fe_2O_3	MgO	SO_3	H_2O at 100°	H_2O ab. 100°
19.51	9.35	38.37	19.53	12.75 = 99.51%

G. = 2.075.

It was also found as a gangue mineral at the Palisades mine, 2 miles north of Calistoga.

ALUNITE

Basic hydrous sulphate of aluminum and potassium, $K_2Al_6(OH)_{12}(SO_4)_4$.

Hexagonal-rhombohedral. Small crystals and massive. Cleavage (0001) distinct. Brittle. Vitreous luster. Color white, sometimes reddish. Streak white. H. = 3½ — 4. G. = 2.58 — 2.75.

Infusible and decrepitates. Turns blue when moistened with cobalt nitrate and intensely heated. Gives water in a closed tube. Slowly soluble in sulphuric but insoluble in hydrochloric acid.

Colusa County: Alunite carrying gold has been found at Sulphur Creek.

Inyo County: Alunite from a deposit in the Funeral Range has been described by Wherry (16). Two analyses of impure material by Bailey gave:

	Na_2O	K_2O	H_2O	Al_2O_3	SO_3	SiO_2
Surface	5.27	3.05	14.87	39.02	30.52	7.46 = 100.19%
60 ft. depth	6.83	1.04	17.60	38.46	25.03	10.27 = 99.23%

Mariposa County: Alunite is a constituent of a quartzite rock found with a greenstone schist in which stellate pyrophyllite occurs, at Tres Cerritos, southwest of Indian Gulch. It was described by Turner (96), (98), with analysis by Valentine.

SO_3	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	H_2O	SiO_2	TiO_2	P_2O_5
38.50	38.05	0.23	0.55	tr.	4.48	2.78	11.92	2.64	0.40	tr. = 99.55%
										G. = 2.78.

Mono County: Massive pink and brown alunite occurs with andalusite at the mine of Champion Sillimanite, Incorporated, on the western slope of the White Mountains, 7 miles east of Mocalno, Kerr (32).

Orange County: It occurs with gypsum in clay and sandstone at San Juan Capistrano Point.

San Bernardino County: It occurs with krausite and other sulphates near Borate, 6 miles northeast of Yermo, Foshag (31b).

Shasta County: Alunite was reported by Anderson (35) as a secondary mineral in the altered lavas at Bumpass Hell and other hot springs in Lassen Volcanic National Park.

JAROSITE

Hydrous potassium and iron sulphate, $K_2O.3Fe_2O_3.4SO_3.6H_2O$.

Hexagonal-rhombohedral. Small platy crystals; fibrous, granular. Cleavage (0001) distinct. Brittle. Vitreous luster. Color yellowish-brown. Streak yellow. H. = $2\frac{1}{2}$ — $3\frac{1}{2}$. G. = 3.15 — 3.26.

Only partially soluble in cold water, otherwise like coquimbite in its reactions.

Mono County: Jarosite has been found in the Blind Spring Hill district near Benton. It occurs with limonite and alunite in the andalusite deposit of Champion Sillimanite, Incorporated, on the western slope of the White Mountains, 7 miles east of Mocalno, Woodhouse (36).

San Benito County: Rogers (12) has reported jarosite crystals showing the forms (0001), $(10\bar{1}1)$, and $(02\bar{2}1)$ from the New Idria quicksilver mine.

San Bernardino County: Jarosite occurs with alunite, coquimbite, krausite, and other sulphates in the Calico Hills near Borate, about 6 miles northeast of Yermo, Foshag (31b).

URACONITE

Hydrous uranium sulphate, SO_3,UO_3,H_2O.

Orthorhombic. Minute laths. Earthy or scaly. Color lemon-yellow. Soft.

In addition to the uranium reaction, the mineral will give water in a closed tube. Soluble in acid.

Calaveras County: Uraconite occurs as an alteration product of pitchblende in coatings in contact with the gold at the Rathgeb mine, near San Andreas, Rickard (95).

TELLURITES

DURDENITE

Hydrous ferric tellurite, $Fe_2(TeO_3)_3.4H_2O$.

Orthorhombic. Massive, spherulitic. Luster vitreous, dull. Color pale greenish-yellow. H. = 2 — 2½.

Fuses on charcoal and leaves a magnetic residue. Soluble in hydrochloric acid.

Calaveras County: A specimen of telluride ore from this county, presumably from Carson Hill, contained along its fractures pale greenish-yellow spherulites, which an optical examination by Larsen (17b) proved to be durdenite.

CHROMATES, MOLYBDATES, TUNGSTATES, and URANATES

Crocoite	Wolframite
	Scheelite
Powellite	Cuprotungstite
Wulfenite	
Ferrimolybdite	Uraninite

CROCOITE

Lead chromate, $PbCrO_4$.

Monoclinic. Long prismatic crystals; granular. Cleavage (110) rather distinct. Sectile. Adamantine to vitreous luster. Color bright-red. Streak orange-yellow. H. = 2½ — 3. G. = 5.9 — 6.1.

Fusible. In the closed tube decrepitates and blackens, but recovers its original color on cooling. With salt of phosphorus gives an emerald-green bead.

Inyo County: Crocoite was found in the Darwin mines with wulfenite.

Riverside County: It occurred with wulfenite in the El Dorado mine, near Indio.

POWELLITE

Calcium molybdate with calcium tungstate, $CaO.(Mo,W)O_3$.

Tetragonal. Minute pyramids. Cleavage (111). Brittle. Resinous luster. Color greenish-yellow. H. = 3½. G. = 4.35 — 4.53.

Fusible with difficulty to a gray mass. Soluble in nitric and hydrochloric acids. A deep-blue solution is obtained by boiling the powdered mineral in a few drops of strong sulphuric acid and adding a pinhead scrap of paper.

Inyo County: Powellite occurs in the Pine Creek tungsten mine at the head of Pine Creek in the Sierra Nevada west of Bishop, Young (26).

Kern County: Powellite occurs in veins in the El Paso Mountains about 12 miles northwest of Randsburg.

Tulare County: It has been found near Lemon Cove.

WULFENITE

Lead molybdate, $PbMoO_4$.

Tetragonal. Thin tabular crystals; sometimes pyramidal. Granular massive. Cleavage (111) perfect. Brittle. Resinous or adamantine luster. Orange-yellow, bright-red, greenish, grayish-white to nearly colorless. Streak white. H. = 2½ — 3. G. = 6.7 — 7.

Easily fusible. Reduced on charcoal, using sodium carbonate as flux, it yields metallic lead and a yellow coating. Powder dissolved in a few drops of strong sulphuric acid by boiling, gives a solution which turns blue when a small amount of organic matter is introduced, a piece of paper the size of a pinhead generally being sufficient; the blue solution turns brown in a short time.

El Dorado County: Wulfenite occurs in small grains near Garden Valley.

Inyo County: Crystals of wulfenite occurred with the linarite and caledonite of the Cerro Gordo mine. It has been observed with crocoite in the Darwin mines.

Kern County: Wulfenite was found 6 miles northeast of Kane Springs, Hanks (84).

Plumas County: It was found at the Diadem lode on Mumford Hill.

Riverside County: It occurs with crocoite at the El Dorado mine, near Indio. It was reported to occur in the gold mines of the Chuckawalla Mountains.

San Bernardino County: Wulfenite was found with cerusite in the Silver Reef district and at Holberg's Gold mine in the Lava Beds district, Storms (93). Crystals of wulfenite from Lavic were described by Guild and Wartman (21). The forms observed were: (001), (012), (011), (113), (111), and (133). It occurs with vanadinite at the Vanadium King mine, near Goffs. It was observed in limestone in the upper part of Black Hawk Canyon, Woodford and Harriss (28).

San Luis Obispo County: It was found at the Fairview mine.

FERRIMOLYBDITE—Molybdite

Hydrous iron molybdate, $Fe_2O_3.3MoO_3.8H_2O$.

Orthorhombic. Fibrous crystals in radiating tufts; earthy. Cleavage (001) distinct. Color sulphur-yellow. H. = 1½. G. = 4.5.

A deep-blue solution is obtained by dissolving the powder in concentrated sulphuric acid and adding a scrap of paper not larger than a pinhead. The solution soon turns brown.

Del Norte County: Ferrimolybdite was found with bornite at French Hill.

Madera County: Ferrimolybdite occurs with molybdenite at Red Mountain in the Ritter Range, Goudey (36).

Mono County: It occurs with molybdenite at Cameron and at Silverado Creek, Whiting (88).

Nevada County: Ferrimolybdite was reported by Owen (52) from the Wisconsin and Illinois claim, near Nevada City. Analysis:

MoO_3	Fe_2O_3	MgO	Alkali	H_2O
40	35	2	8	15 = 100%

Shasta County: It occurs with molybdenite on Boulder Creek west of Gibson Siding.

WOLFRAMITE

Iron and manganese tungstate, $(Fe,Mn)WO_4$.

Monoclinic. Thick tabular crystals and massive. Perfect clinopinacoidal cleavage. Brittle. Metallic to submetallic. Dark-grayish or brownish-black, brownish-red. Thin splinters sometimes deep red. Streak dark-brown to black. H. = 5 — 5½. G. = 7 — 7.5.

Fusible, but rather insoluble. Fused with sodium carbonate, gives blue-green fusion; the fused mass dissolved in hydrochloric acid and boiled with metallic tin, the solution becomes deep blue, later turning to brown. The phosphorous salt bead of tungsten in the reducing flame is a fine blue.

Inyo County: Boulders of black wolframite have been found in Death Valley.

Kern County: It occurs with chalcopyrite at Woody.

Madera County: Large crystals and masses of wolframite weighing several pounds occur in a quartz vein in andalusite schist on the IXL claim, about 12 miles north of Raymond. Pyrite is an accessory mineral, Hess (08). Brownish-black crystals of wolframite associated with large cubes of pyrite occur in a quartz vein in micro-pegmatitic granite at the head of Iron Creek, Ritter Range, Minaret Mining district, Erwin (34).

Mariposa County: Wolframite crystals have been found near Buchanan.

San Bernardino County: Wolframite has been found with scheelite at the Jack claim, near Nipton, in the Clark Mountains, Hess (17). It occurs in a quartz vein with chalcopyrite, sphalerite, and galena at the Sagamore mine, New York Mountains.

SCHEELITE

Calcium tungstate, $CaWO_4$.

Tetragonal. Pyramidal crystals and massive. Pyramidal cleavage. Vitreous luster. Color white, yellow, brown. Streak white. H. = $4\frac{1}{2}$ — 5. G. = 5.9 — 6.1.

Difficult to fuse and only soluble by boiling in strong hydrochloric acid; the solution becomes bright yellow and tungstic oxide is precipitated. On the addition of tin and boiling, the solution turns blue and later brown. Ammonia and ammonium oxalate added to the diluted hydrochloric acid solution will precipitate the calcium.

Scheelite is the principal tungsten mineral of the State, and important deposits exist. It is frequently found in isolated crystals and patches in quartz-feldspar veins. Scheelite is fluorescent by ultraviolet light, the use of which has recently become of considerable aid to operators and prospectors.

El Dorado County: A small production of scheelite has been made from the Comeback Consolidated mine, in Sec. 4, T. 11 N., R. 11 E., M. D. M., near Kelsey.

Fresno County: Scheelite was found at a contact of limestone and granite near Trimmer.

Inyo County: In the Tungsten Hills and along the foot of the Sierra Nevada near Bishop there are many scheelite deposits in metamorphic rocks surrounded by graphite, Knopf (17). At the Aeroplane group of claims in the Tungsten Hills and at the Mac Van claim on Rawson Creek scheelite occurs with garnet and epidote; at the Chipmunk prospect 6 miles southwest, and at the Mineral Dome prospect 3 miles south of Bishop, it is in garnet rock; in the Jackrabbit and Little Sister claims in the Tungsten Hills it is distributed through

fine-grained metamorphic rocks. Crystals of scheelite may be found in epidote at the Buckshot claim near the mouth of Shannon Canyon, 11 miles south of Bishop. Scheelite occurs in quartz veins cutting metamorphic rocks at Round Valley on the north side of the Tungsten Hills 9 miles west of Bishop, Chapman (37).

Scheelite occurs with garnet and diopside at the Pine Creek tungsten deposit, near the head of Morgan Creek, about 18 miles west of Bishop, Hess and Larsen (21), Young (26).

Kern County: Small amounts of scheelite occur in the Amalie, Rand, and Stringer districts, associated with gold. It occurs in the Yellow Aster mine, Randsburg, and in the Winnie, Sidney, and other mines of the Stringer district, Hulin (25). Scheelite from the Sidney mine has been analyzed by R. C. Wells, Clarke (15):

WO_3	CaO	SiO_2	$(Al,Fe)_2O_3$	MgO
78.27	19.82	1.28	0.37	0.38 = 100.12%

In the Amalie district it occurs in Jawbone Canyon with pyrite and gold-bearing galena. It occurs with molybdenite and possibly powellite in the Black Mountains about 20 miles northwest of Randsburg.

Several scheelite deposits in the Greenhorn Mountains have been described by Storms (16) and by Hess and Larsen (21). Scheelite occurred with pyrrhotite at the Rand claims on Cedar Creek, Secs. 19 and 20, T. 25 S., R. 32 E., M. D. M.

Mono County: Scheelite occurs with garnet in a contact metamorphic deposit about 8 miles south of Benton, Hess and Larsen (21). Scheelite occurs in a metamorphosed limestone, on the west side of Hilton Creek, half a mile north of Davis Lake, 30 miles northwest of Bishop, Mayo (34).

Nevada County: A few brownish-yellow masses of scheelite were found in a quartz ledge at Howard Hill, Grass Valley, Hanks (84). Small amounts of reddish-brown scheelite occurred at the 3000-foot level of the Empire mine, Grass Valley. Veins of white scheelite intermixed with quartz and feldspar occur at the Union Hill mine, Grass Valley.

Riverside County: Scheelite occurs with quartz, garnet and epidote in a metamorphosed limestone surrounded by granite about 9 miles east of Aguanga, Hess and Larsen (21).

San Bernardino County: Important veins of scheelite occur at Atolia in the Papoose and other claims, Hulin (25). Scheelite from the Papoose mine has been analyzed by R. C. Wells, Clarke (15):

WO_3	CaO	SiO_2	$(Al,Fe)_2O_3$	MgO
77.81	18.67	2.00	0.09	none = 98.57%

The scheelite occurs in quartz-feldspar veins and is generally intimately mixed with the gangue, forming a low-grade ore, though in places the veins have yielded as much as 3 feet in width of practically pure, massive scheelite, Shannon (20). Scheelite occurs in clear pyramidal crystals with garnet and epidote in limestone at a contact with granite in the Morongo district.

Small deposits of scheelite occur at a contact of limestone with mica schist about 15 miles northwest of Victorville, Surr (08).

San Diego County: Massive brown scheelite has been found at Julian. It occurs in quartz 5 miles southeast of Laguna Mountains.

Siskiyou County: Scheelite in crystals has been observed at Scott Bar.

Tulare County: Scheelite occurs in a garnet gangue at the Tungsten mine, near Posey.

Tuolumne County: A small amount of scheelite has been found on the Mackey ranch, 3 miles from Jamestown.

CUPROTUNGSTITE

Hydrous copper tungstate, $WO_3.2CuO.H_2O$.

Cryptocrystalline, fibrous. Color green. H. = 4½.

Kern County: Material found with radiating black tourmaline at the Green Monster mine, 12 miles east of White River, was first reported as cuproscheelite, Hanks (73); later examination proved it to be scheelite with admixed cuprotungstite, Schaller (32).

URANINITE—Pitchblende

Uranate of uranyl, lead, and the rare earths.

Isometric. Crystals rare. Generally massive and botryoidal. Brittle. Submetallic to pitch-like luster. Color and streak grayish, greenish, brownish-black. H. = 5½. G. = 9 — 9.7 crystals; massive altered forms from 6.4 upwards.

Before the blowpipe infusible. With borax and salt of phosphorous gives a yellowish-green bead in the oxidizing flame, becoming a fine clear green in the reducing flame. Soluble in nitric and sulphuric acids. Strongly radioactive.

Calaveras County: Uraninite was found in acicular crystals in a pocket with spongy gold, quartz, and clay at the Rathgeb mine, near San Andreas, Rickard (95).

NIOBATES, TANTALATES

Pyrochlore Microlite Columbite—Tantalite Stibiotantalite

The niobate-tantalate group is characteristic of acid pegmatite veins. The minerals are mostly of high specific gravity, varying in color from yellow to brown and black, and often contain the rare-earth oxides.

PYROCHLORE

Niobate of the cerium metals, calcium, and other bases, with titanium, thorium, fluorine.

Isometric. Commonly in octahedrons. Cleavage octahedral. Brittle. Luster vitreous or resinous. Color dark reddish-brown. Streak light yellowish-brown. H. = 5 — 5½. G. =4.2 — 4.36.

Infusible and insoluble. Fused with borax, the fused mass powdered may be dissolved in hydrochloric acid. If metallic tin is added and the solution boiled down to small bulk, the color of the solution becomes at first violet, due to titanium, and then blue, due to the niobium.

San Diego County: A dark-brown isotropic mineral, presumably pyrochlore, surrounded by microlite, came from some locality in the county, Rogers (12).

MICROLITE

Tantalate of calcium, $Ca_2Ta_2O_7$.

Isometric. Often small octahedrons. Brittle. Luster resinous. Color pale-yellow to brown. H. = 5½. G. = 5.5.

The reactions are similar to those for pyrochlore. Fused with potassium bisulphate or potassium hydroxide, the fusion dissolved in hydrochloric acid, and the solution boiled down with tin, it assumes a deep-blue color.

San Diego County: Microlite has been found in the county, exact locality unknown, as a honey-yellow mineral associated with albite, lepidolite, tourmaline, and colorless apatite. A few crystals are octahedral with narrow faces of (011) and (311), Rogers (12).

COLUMBITE—Tantalite

Niobate and tantalate of iron and manganese, $(Fe,Mn)(Nb,Ta)_2O_6$.

Orthorhombic. Prismatic crystals, massive. Cleavage (100) good. Brittle. Submetallic luster. Color iron-black, brownish-black. Streak dark-red to black. H. = 6. G. = 5.3 — 7.3.

Fused with potassium bisulphate, then dissolved in hydrochloric acid and the solution boiled down with tin, it assumes a deep-blue color. Gives the green color of manganese when fused with sodium carbonate. Insoluble.

Fresno County: Massive and crystalline black columbite has been found at the Reynolds mine, Kings River district.

San Diego County: A crystal of columbite from the Little Three mine, near Ramona was described by Eakle (07). Forms: (100),

(010), (110), (130), (150), (160), (021), (111), (221), (211), (121), (131), and (141). Small imperfect crystals found at the Victor mine, Rincon, have the forms (100), (210), (130), (103), and (133), Rogers (10). It occurs in good crystals associated with cassiterite, tourmaline, albite, and orthoclase in the Chihuahua Valley, Schaller (16c). Tantalite, rich in manganese, from the Catharina mine, near Pala was analyzed by Schaller, Clarke (15):

$(Nb,Ta_2)O_5$	MnO	FeO	Gangue (by difference)
79.39	14.87	1.72	4.02 = 100%

STIBIOTANTALITE

Niobate and tantalate of antimony, $Sb_2O_3.(Nb,Ta)_2O_5$.

Orthorhombic. Hemimorphic prisms, twinned. Cleavage (100) perfect. Resinous to adamantine luster. Color light-brown to dark-brown. H. = 5 — 5½. G. = 5.98 — 7.37, mostly 6.6 — 6.7. Pyroelectric.

Reduced on charcoal with sodium carbonate, it gives a white coating and metallic brittle bead of antimony. Fused with potassium bisulphate, fusion dissolved in hydrochloric acid, and the solution boiled down with metallic tin, assumes the blue color due to niobium and tantalum.

San Diego Caunty: Stibiotantalite was found in small amounts in the pegmatite veins at Mesa Grande associated with gem tourmaline, pink beryl, quartz, orthoclase, lepidolite, and cassiterite. It was described and analyzed by Penfield and Ford (06). Forms: (100), (110), (130), (209), (203), (4.12.9), (043), $(\bar{1}00)$, $(\bar{1}10)$, $(\bar{1}30)$, $(\bar{2}09)$, $(\bar{2}03)$, and $(\bar{4}.12.9)$.

Nb_2O_5	Ta_2O_5	Sb_2O_3	Bi_2O_3	
18.98	36.35	44.26	0.33 = 99.92%	G. = 6.72
39.14	11.16	49.28	0.53 = 100.11%	G. = 5.98

The mean of three analyses of this stibiotantalite by Foote and Langley (10) gave:

Sb_2O_3	Bi_2O_3	Ta_2O_5	Nb_2O_5
40.95	0.60	41.92	16.19 = 99.66%

PHOSPHATES, ARSENATES, VANADATES, and ANTIMONATES

Xenotime
Monazite
Pucherite
Triphylite
Lithiophilite

Apatite Group
Apatite
Collophane
Dahllite
Wilkeite
Ellestadite
Pyromorphite
Mimetite
Vanadinite

Triplite
Woodhouseite
Plumbogummite
Amblygonite
Adamite
Descloizite
Calciovolborthite
Lazulite
Arseniosiderite
Anapaite
Palaite
Stewartite
Vivianite
Erythrite
Annabergite

Scorodite
Strengite
Variscite
Purpurite
Sicklerite
Salmonsite
Hureaulite
Volborthite
Turquois
Augelite
Liroconite
Autunite
Bindheimite
Diadochite
Pitticite

XENOTIME

Yttrium phosphate, YPO_4.

Tetragonal. In crystals resembling zircon. Perfect prismatic cleavage. Brittle. Luster resinous to vitreous. Color and streak yellowish-brown. H. = 4 — 5. G. = 4.45 — 4.56.

Infusible. Insoluble in acids.

Riverside County: Xenotime was found in well-formed crystals in pegmatite at the Southern Pacific Silica quarry near Nuevo, Melhase (36). It was also reported from a pegmatite 2 miles north of Winchester.

MONAZITE

Phosphate of the rare earths, $(Ce,La,Pr,Nd)PO_4$.

Monoclinic. Crystals rare. Commonly in grains as sand. Cleavage (001) perfect, (100) distinct. Brittle. Vitreous to resinous luster. Color yellowish-brown, sometimes reddish. H. = 5 — 5½. G. = 5.0 — 5.2.

B. B. infusible. Fused with sodium carbonate and the fusion dissolved in nitric acid, the solution will give a lemon-yellow precipitate on the addition of ammonium molybdate. Decomposed by concentrated sulphuric acid and the solution treated with ammonium oxalate, will precipitate the rare earth metals cerium, lanthanum, etc.

Butte County: Traces of monazite have been found in the black sands of Little Rock Creek.

Del Norte County: It was observed in the black sands at Crescent City and on Gilbert Creek, Day and Richards (06).

El Dorado County: Traces of it have been found in the concentrates of the Brownsville district and at Placerville.

Humboldt County: It was observed at Trinidad.

Placer County: Traces of it occur at Michigan Bluff.

Plumas County: It occurs in the sand at Nelson Point.

Riverside County: Monazite is a conspicuous constituent of a pegmatite in the Southern Pacific Silica quarry near Nuevo, Dykes (33), Melhase (36). It is also found in pegmatites about 2 miles north of Winchester and just east of Riverside at the foot of the Box Springs Mountains. Crystals of monazite have been found with albite in a pegmatite about 200 yards west of the Jensen limestone quarry in the Jurupa Mountains.

Yuba County: Traces of it occur in the Brownsville district.

PUCHERITE

Bismuth vanadate, $BiVO_4$.

Orthorhombic. Tabular and acicular crystals. Perfect basal cleavage. Color reddish-brown. Streak yellow. H. = 4. G. = 6.25.

Fused on charcoal with mixture of potassium iodide and sulphur, a red sublimate is obtained mixed with greenish-yellow. The phosphorous salt bead of vanadium is yellow in the oxidizing flame and emerald green in the reducing flame. Soluble in hydrochloric acid.

San Diego County: Pucherite occurs at the Pala Chief mine, near Pala. It was analyzed by Schaller (11a).

			H_2O		
Bi_2O_3	V_2O_5	Insol.	at 107°	at 240°	Ign.
66.14	25.80	7.37	0.21	0.32	0.84 = 100.68%

TRIPHYLITE

Lithium and iron phosphate, $LiFePO_4$.

Orthorhombic. Commonly massive. Cleavage perfect basal. Vitreous luster. Color greenish-gray to bluish. Streak uncolored to grayish-white. H. = 4½ — 5. G. = 3.42 — 3.56.

Easily fusible and soluble. Ammonium molybdate added to a nitric acid solution precipitates yellow ammonium phospho-molybdate. Yields a red lithium flame when fused.

This rare phosphate usually contains manganese and grades into lithiophilite.

San Diego County: Triphylite was found with lithiophilite and purpurite in the lithia mines at Pala, Graton and Schaller (05).

LITHIOPHILITE

Lithium and manganese phosphate, $LiMnPO_4$.

Orthorhombic. Commonly massive. Cleavage perfect basal. Vitreous luster. Color pale-pink to yellow and brown. H. = 4½ — 5. G. = 3.42 — 3.56.

Easily fusible. Fuses with a red flame. The sodium carbonate bead is blue-green. Soluble in acid. The phosphate reaction is obtained when ammonium molybdate is added to the nitric acid solution.

San Diego County: Lithiophilite was found with triphylite and purpurite at Pala, Graton and Schaller (05). Analyzed by Schaller, Clarke (15).

P_2O_5	FeO	MnO	CaO	Fe_2O_3	H_2O-	H_2O+	Li_2O
43.01	12.54	30.66	0.38	2.24	0.70	1.35	3.73
					Na_2O	Insol.	
					4.97	0.43 = 100.01%	

APATITE GROUP

APATITE

Calcium chloro- and fluo-phosphate, $Ca_5(Cl,F)(PO_4)_3$.

Hexagonal. Prismatic and tabular crystals. Massive, granular to compact. Brittle. Vitreous to greasy luster. Colorless, green, yellow, and brown. Streak white. H. = $4\frac{1}{2}$ — 5. G. = 3.17 — 3.23.

Practically infusible, but easily soluble. Ammonium molybdate precipitates much canary-yellow granular powder. Calcium can be determined by dissolving apatite in hydrochloric acid, adding ammonia to precipitate the calcium phosphate, redissolving this precipitate with just enough drops of acid, and then adding ammonium oxalate, which will precipitate the calcium. Some varieties will give a fluorine reaction.

Apatite has been observed as small crystals in many of the rocks of the State.

Voelckerite is a variety containing little or no chlorine or fluorine. Its formula may be written $3Ca_3(PO_4)_2.CaO$. The variety voelckerite seems to be characteristic of the glaucophane schists in the Coast Ranges.

Amador County: A veinlet of apatite cutting earlier gold-bearing quartz in the Kennedy mine at Jackson was described by Hulin (30).

Calaveras County: An occurrence of apatite in gneiss on the North Fork of Mokelumne River, east of the Bear River has been described by Turner (02).

Contra Conta County: It is found in brownish masses in the schists north of Berkeley.

Fresno County: Apatite occurs with garnet, epidote, andalusite, and tourmaline in a pegmatite in Clarks Valley, 9 miles east of Sanger, Melhase (35a).

Placer County: An earthy lime phosphate has been found near Dutch Flat.

Plumas County: Apatite is a constituent of the syenite of Spanish Peak, Murgoci (06).

Riverside County: Greenish-blue apatite occurred as granular masses in white calcite, associated with diopside and wollastonite, at Crestmore, Eakle (17).

San Bernardino County: Small crystals of apatite were found in limestone on the east end of the Kingston Range.

San Diego County: It occurs in the gneiss at Dehesa with dumortierite, Schaller (05). Tabular crystals of violet and pink apatite occurred at the old Mack mine, near Rincon. At the Victor mine, Rincon, pale dirty-green crystals of apatite occurred with the forms: (0001), $(10\bar{1}0)$, $(11\bar{2}1)$, $(10\bar{1}2)$, $(10\bar{1}1)$ and $(31\bar{4}1)$, Rogers (10).

Crystals of apatite were also found in pegmatite on Smith Mountain, at Mesa Grande, and at Aguanga. Small crystals of apatite occur in limestone near Jacumba, and near Grapevine Camp.

Santa Clara County: Voelckerite occurs in veinlike patches in glaucophane schist in the Calaveras Valley. Analysis by G. W. Jordan, Rogers (14) gave:

CaO	Al_2O_3	FeO	P_2O_5	H_2O	CO_2	Insol.	
54.46	1.35	0.24	41.47	0.22	1.03	0.53 = 99.30%	G. = 3.06

COLLOPHANE

$3Ca_3(PO_4)_2.nCa(CO_3,F_2,O)(H_2O)_x$.

Amorphous. Massive or granular. Color white, brown, gray. H. = 3 — 5. G. = 2.6 — 2.9.

Easily soluble in acids.

Collophane is the chief constituent of phosphorite and bone phosphate.

Fresno County: Galliher (31) has analyzed impure granular collophane from sediments penetrated by Pacific Western well KOC No. 27.

Fe_2O_3	CaO	MgO	P_2O_5	CO_2	S	H_2O	Insol.
2.1	41.2	tr.	30.7	3.7	1.4	11.1	9.8 = 100.0%

Humboldt County: Collophane occurs with dahllite near Yager.

Los Angeles County: Collophane has been found in the Graham Brothers' quarry near Lomita.

Monterey County: Collophane occurs in beds of phosphate rock in Vaquero Canyon, Reed (27).

DAHLLITE

Calcium phosphate and carbonate, $3Ca_3(PO_4)_2.CaCO_3$.

Hexagonal. Minute crystals, crusts, spherulites. Colorless to pale-brown or gray. H. = 5. G. = 3.08.

Reactions similar to apatite, but effervesces slightly in warm acid.

Humboldt County: Dahllite has been found with collophane near Yager.

WILKEITE

$3Ca_3(PO_4)_2.CaCO_3+3Ca_3[(SiO_4)(SO_4)].CaO$.

Hexagonal. Small prismatic crystals and grains. Vitreous. Pale rose-red. H. = 5. G. = 3.234.

Infusible. Soluble in nitric acid.

This rare mineral is unlike any other in having four acid radicals. It resembles apatite in physical properties.

Riverside County: Wilkeite, discovered at Crestmore, occurs in blue calcite associated with diopside, idocrase, garnet, and its alteration product, crestmoreite, and was analyzed and named by Eakle and Rogers (14).

CaO	MnO	P_2O_5	SO_3	SiO_2	CO_2	H_2O
54.44	0.77	20.85	12.28	9.62	2.10	tr. = 100.06%

Crystal forms $(10\bar{1}0)$, $(11\bar{2}0)$, $(10\bar{1}1)$, and (0001) were observed by Eakle (17).

A variety poor in phosphate, also found at Crestmore, has been named *ellestadite* by McConnell (37). It was analyzed by R. B. Ellestad:

CaO	MgO	MnO	P_2O_5	SO_3	SiO_2	CO_2	Cl
55.18	0.47	0.01	3.06	20.69	17.31	0.61	1.64

F	H_2O-	H_2O+	Fe_2O_3	Al_2O_3	O		
0.57	0.10	0.53	0.22	0.13 = 100.52	— 0.61 = 99.91%	G. = 3.068.	

PYROMORPHITE

Lead chloro-phosphate, $(PbCl)Pb_4(PO_4)_3$.

Hexagonal. Prismatic crystals; often globular, reniform, and botryoidal. Brittle. Resinous luster. Color green, yellow, brown; also grayish-white to milk-white. Streak white. H. = 3½ — 4. G. = 6.5 — 7.1.

Fuses easily on charcoal and yields a lemon-yellow coating when reduced. The phosphate reaction can be obtained by dissolving pyromorphite in nitric acid and adding ammonium molybdate.

Pyromorphite is found as an alteration product of galena and cerusite.

Calaveras County: Green crystals of pyromorphite have been found in gold quartz at the Reliance mine.

El Dorado County: It occurred as a yellowish-green coloring matter in botryoidal chalcedony and as a crystalline coating, at Mosquito Gulch, 6 miles northeast of Placerville, Turner (02).

Inyo County: It was found in small amounts in the Cerro Gordo district.

Mariposa County: A small amount of pyromorphite was found in the mines near Coulterville.

Riverside County: It was found in crystals at the 300-foot level of the El Dorado mine.

Shasta County: Blake (67) reported the occurrence of pyromorphite with tetrahedrite, galena, and cerusite on the Chicago claim.

Tulare County: It was found in the White Chief mine, Mineral King district, Goodyear (88).

MIMETITE

Lead chloro-arsenate, $(PbCl)Pb_4(AsO_4)_3$.

Hexagonal. Prismatic crystals, rounded to globular forms. Brittle. Resinous luster. Pale-yellow, light-brown, colorless. Streak white. H. = 3½. G. = 7 — 7.25.

Fusible. Reduced on charcoal to metallic lead and gives a yellow coating, using sodium carbonate as flux. Powder heated in a closed tube with a splinter of charcoal above it, becomes reduced to metallic arsenic, which forms a ring around the walls of the glass. Gives a slight chlorine reaction with nitric acid and silver nitrate. Soluble in nitric acid.

Inyo County: Mimetite is one of the numerous minerals occurring in the Cerro Gordo mines.

Kern County: It was found with galena near Randsburg.

San Bernardino County: Small amounts of mimetite were found in the Morning Star mine, Lava Beds district, near Lavic.

VANADINITE

Lead chloro-vanadate, $(PbCl)Pb_4(VO_4)_3$.

Hexagonal. Small prisms. Brittle. Somewhat resinous luster. Color deep ruby-red, straw-yellow, reddish-brown. Streak white or yellowish. H. = 3. G. = 6.66 — 7.10.

Fused on charcoal with sodium carbonate, the mineral is reduced to metallic lead with a yellow sublimate on the coal. The green bead of vanadium can be obtained with phosphorous salt. Dissolved in nitric acid and a drop of silver nitrate added to the solution, silver chloride will be precipitated. Decomposed by hydrochloric acid.

Kern County: Vanadinite has been found 2 miles north of Searles Lake. It was found with galena and mimetite near Randsburg.

San Bernardino County: Vanadinite occurs with cerusite and cuprodescloizite in the Vanadium King mine at Camp Signal, near Goffs, Schaller (11b). It was found near Moore Station on the Union Pacific Railroad.

TRIPLITE

Fluo-phosphate of iron and manganese, $3(Mn,Fe)O.P_2O_5.MnF_2$.

Monoclinic. Massive. Cleavage (100) distinct. Luster resinous inclining to adamantine. Color pink, brown to black. Streak yellowish-gray or brown. H. = 4 — 5½. G. = 3.44 — 3.8.

Fuses easily to a black magnetic globule. With borax it gives an amethystine bead and with sodium carbonate a green bead. Soluble in hydrochloric acid. Usually gives a fluorine test when dissolved with sulphuric acid.

Triplite is a rare mineral usually found with tungsten minerals in pegmatite veins.

San Bernardino County: Triplite was found with hübnerite on specimens from a deposit at Camp Signal, about 9 miles north of Goffs, Hess (17).

San Diego County: Triplite derived from lithiophilite was found at Pala. Analyzed by Schaller, Clarke (15).

P_2O_5	FeO	MnO	Mn_2O_3	CaO	H_2O —	H_2O +	F
31.12	3.32	51.86	a3.45	3.38	0.09	0.78	8.27

Insol. 0.62 = 102.89 — O = F 3.48 = 99.41% G. = 3.84.

a = admixed.

WOODHOUSEITE

Hydrous sulphate-phosphate of aluminum and calcium, $2CaO.3Al_2O_3.P_2O_5.2SO_3.6H_2O$.

Hexagonal-rhombohedral. Rhombohedral crystals. Basal cleavage. Vitreous to pearly luster. Colorless or flesh-colored; transparent or translucent. H. = 4½. G. = 3.012.

Readily soluble in dilute acid. Yields water when heated in closed tube.

Mono County: Woodhouseite occurs in veins with quartz, topaz, lazulite and augelite in the andalusite deposit at the mine of Champion Sillimanite, Incorporated, on the western slope of the White Mountains, 7 miles east of Mocalno. It was described and named by Lemmon (37). Crystals show the forms: (0001), $(10\bar{1}1)$, $(40\bar{4}1)$, $(50\bar{5}1)$, and $(02\bar{2}1)$. An analysis of woodhouseite by A. Rautenberg has been reported by Lemmon (37).

P_2O_5	SiO_2	Al_2O_3	CaO	SrO	BaO	MgO	Na_2O	K_2O	SO_3	H_2O-	H_2O+
18.13	0.30	36.63	12.31	0.25	1.00	0.11	0.08	0.02	17.59	0.20	13.25 = 99.87%

PLUMBOGUMMITE

Hydrous lead and aluminum phosphate, $2PbO.3Al_2O_3.2P_2O_5.7H_2O$.

Hexagonal. Gumlike, incrustations, compact massive. Resinous luster. Color yellowish, brownish. Streak uncolored. H. = 4 — 5. G. = 4 — 4.9.

Fused on charcoal with sodium carbonate, a yellow coating and metallic globule of lead are obtained. The nitric acid solution gives the phosphate reaction on adding ammonium molybdate. Yields water in a closed tube.

Inyo County: Plumbogummite has been found at the Cerro Gordo mine.

AMBLYGONITE

Lithium aluminum fluo-phosphate, $LiAl(F,OH)PO_4$.

Triclinic. Crystals large and coarse. Generally massive. Cleavage perfect basal. Brittle. Vitreous to pearly luster. Color white to pale-bluish. Streak white. H. = 6. G. = 3.01 — 3.09.

Easily fusible, giving the red flame of lithium. Fused with sodium carbonate and then boiled with nitric acid, the phosphate reaction is obtained on the addition of ammonium molybdate to the solution. Soluble in sulphuric acid.

Amblygonite is an important lithia mineral, but only a few deposits are known in the State.

Riverside County: Amblygonite occurs with tourmaline, beryl, kunzite, and lepidolite in a pegmatite dike at the Fano Mine, on the north side of Coahuila Mountain about a mile south of Bautista Creek, Kunz (05).

San Diego County: A large mass of white massive amblygonite occurred at the Stewart mine in a pegmatite vein carrying rubellite and lepidolite. It was analyzed by Schaller (04).

P_2O_5	Al_2O_3	Fe_2O_3	MnO	MgO	Li_2O	Na_2O	H_2O	F	TiO_2	O
48.83	33.70	0.12	0.09	0.31	9.88	0.14	5.95	2.29	none = 101.31	— 0.96 = 100.35%

Amblygonite is also found in other pegmatites near Pala.

Massive amblygonite occurs on Aguanga Mountain associated with blue tourmaline and cassiterite.

A few small specimens of white cleavable amblygonite have been found at the Victor mine at Rincon, Rogers (10).

ADAMITE

Basic zinc arsenate, $Zn_3As_2O_8.Zn(OH)_2$.

Orthorhombic. Small crystals, crusts, or granular aggregates. Brittle. Luster vitreous. Colorless, honey-yellow, violet, rose-red, green. Streak white. H. = 3½. G. = 4.34 — 4.35.

Fusible. Soluble in hydrochloric acid.

Inyo County: Small, colorless crystals of adamite occurring on limestone at Chloride Cliff in the Amargosa Range, have been described by Murdoch (36b). They show the forms: (100), (110), (210), (011), and (013).

DESCLOIZITE

Lead and zinc vanadate, $4RO,V_2O_5.H_2O$; R = Pb,Zn.

Orthorhombic. Short prisms. Drusy surfaces and crusts; also massive. Greasy luster. Color cherry-red, yellowish-brown, black. Streak orange to brownish-red. H. = 3½. G. = 5.9 — 6.2.

Easily fusible. Blowpipe reactions are similar to those for vanadinite. Ammonia added to a nitric acid solution may show blue solution of copper. Reaction can also be obtained for zinc by heating coating on charcoal with cobalt nitrate. Gives a small amount of water in a closed tube.

Cuprodescloizite is a variety with about half of the zinc replaced by copper.

San Bernardino County: Minute colorless and yellowish plates of cuprodescloizite showing the forms (100), (001), (011), and (010), occur with cerusite and vanadinite at Camp Signal, Schaller (11b), (12a).

CALCIOVOLBORTHITE

Hydrous copper and calcium vanadate, $(Cu,Ca)_3V_2O_8.(Cu,Ca)(OH)_2$.

Monoclinic? Scales, rosettes, grains. Pearly luster. Color green, gray. Streak greenish-yellow, brownish-yellow. H. = 3½. G. = 3.495 — 3.860.

Easily fusible.

San Bernardino County: Calciovolborthite has been reported to occur at Camp Signal, near Goffs: Schrader, Stone and Sanford (17).

LAZULITE

Basic aluminum, iron and magnesium phosphate, $(Fe,Mg)Al_2(OH)_2P_2O_8$.

Monoclinic. Sharp pointed pyramids. Massive, granular. Brittle. Vitreous luster. Color azure-blue. Streak white. H. = 5 — 6. G. = 3.05.

Infusible. Falls to pieces when heated. Fused with sodium carbonate and then dissolved in nitric acid, the phosphate reaction is obtained by adding ammonium molybdate. Yields water in a closed tube. Insoluble.

Inyo County: Lazulite occurs in a white quartz vein intersecting schist in Breyfogle Canyon, Death Valley.

Los Angeles County: It is found in the San Gabriel Mountains.

Mono County: Lazulite occurs as bands in a white quartzite associated with rutile, near Mono Lake. Lazulite occurs with andalusite and pyrophyllite at the mine of Champion Sillimanite, Incorporated, on the western slope of the White Mountains, 7 miles east of Mocalno, Knopf (17a), Kerr (32). Lazulite was found in a quartz vein in Green Creek Canyon, near Bodie, Rogers (12).

San Diego County: Lazulite has been reported in the rock at Oceanside.

ARSENIOSIDERITE

Basic calcium and iron arsenate, $Ca_3Fe(AsO_4)_3.3Fe(OH)_3$.

Tetragonal or orthorhombic. In fibrous concretions. Basal cleavage. Luster silky. Color yellowish-brown. H. = $1\frac{1}{2}$. G. = 3.5 — 3.9.

Easily fusible. Soluble in acid.

San Bernardino County: Arseniosiderite was found by B. N. Moore at the Gallinger-Root mines, 2 miles northwest of Ludlow. Analyses by Charles Milton, Wells (37).

	SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO	MnO	As_2O_5	P_2O_5	H_2O-	H_2O+
a	3.07	36.45	tr.	14.14	0.17	tr.	37.65	0.18	0.30	8.06 = 100.02%
b	*18.59	27.03	2.41	11.93	---	0.84	31.16	---	0.53	8.45 = 100.94%

* Includes insoluble.

ANAPAITE

Hydrous calcium and iron phosphate, $(Ca,Fe)_3(PO_4)_2.4H_2O$.

Triclinic. Usually in tabular crystals. Cleavage (101), (010). Vitreous. Color pale-green. H. = $3\frac{1}{2}$. G. = 2.8.

Soluble in nitric acid; a yellow precipitate is obtained by adding ammonium molybdate to the acid solution. Anapaite becomes magnetic on heating. Gives water in a closed tube.

Kings County: Anapaite was found in the Lewis well, Sec. 23, T. 21 S., R. 21 E., M. D. M., at a depth of 500 feet, in layers of pale-green crystals.

PALAITE

Hydrous manganese phosphate, $5MnO.2P_2O_5.4H_2O$.

Monoclinic? Crystalline masses. Color flesh-pink. G. = 3.2.
Easily fusible. Readily soluble in acid.

San Diego County: Palaite was found as an alteration product of lithiophilite in the Stewart mine at Pala. It was described and analyzed by Schaller (12b). Analysis:

FeO	MnO	CaO	Fe_2O_3	P_2O_5	H_2O+	Li_2O	Insol.	
7.48	40.87	1.77	0.16	39.02	10.43	tr.	0.89 = 100.62%	G. = 3.14 — 3.20

STEWARTITE

Hydrous manganese phosphate, $3MnO.P_2O_5.4H_2O$.

Triclinic. In fibers or minute crystals. Cleavage (010). Colorless to yellow. G. = 2.94.

Reacts similarly to hureaulite.

San Diego County: Stewartite was found as an abundant alteration product of lithiophilite in the Stewart mine at Pala. It was described and named by Schaller (12b).

VIVIANITE

Hydrous ferrous phosphate, $Fe_3P_2O_8.8H_2O$.

Monoclinic. Long prismatic crystals, earthy, incrustations. Cleavage perfect clinopinacoidal. Sectile. Pearly to dull luster. Color generally sky-blue or green, rarely colorless. Streak colorless to bluish-white. H. = $1\frac{1}{2}$ — 2. G. = 2.58 — 2.68.

Easily fusible to a black magnetic mass. Ammonium molybdate added to a nitric acid solution gives the yellow phosphate reaction. Yields water in a closed tube. Soluble in hydrochloric acid.

Vivianite is formed in sedimentary rocks, from phosphatic matter such as bones, in the presence of iron.

Alameda County: Small pieces of earthy blue vivianite were found in the hills back of Berkeley and were reported by Hanks (84).

Calaveras County: It has been found at Copperopolis.

Humboldt County: Vivianite occurs at Yager. It is reported to have been found on Maple Creek.

Los Angeles County: Vivianite was early observed as earthy blue masses in the asphalt bed of the Rancho de la Brea, where it formed by the decomposition of the bones of extinct animals. It was mentioned by W. P. Blake (82a).

Madera County: Dark-blue earthy masses of vivianite have been found near Raymond.

Yuba County: Good crystals of vivianite occurred near Camptonville and were described by Jackson (86). They showed the forms: (010), (100), (110), (111), (101), (411), and (410).

ERYTHRITE—Cobalt Bloom

Hydrous cobalt arsenate, $Co_3As_2O_8.8H_2O$.

Monoclinic. Crystals prismatic. Incrustations, earthy. Cleavage perfect clinopinacoidal. Sectile. Pearly to adamantine luster. Color and streak crimson to gray. H. = $1\frac{1}{2}$ — $2\frac{1}{2}$. G. = 2.95.

Gives a gray coating of arsenic oxide on charcoal. A little of the well-roasted powder fused in borax bead, gives the fine blue bead of cobalt. Yields water in closed tube. Soluble in hydrochloric acid.

Coatings and incrustations of erythrite are common on primary cobalt minerals, and often serve to locate cobalt.

Calaveras County: Erythrite occurs with smaltite in a stringer between schist and quartzite in the NW¼ Sec. 21, T. 4 N., R. 14 E., M. D. M., Logan (24).

Los Angeles County: Coatings of erythrite with smaltite, argentite and barite occurred at the old Kelsey and O. K. mines near the San Gabriel Canyon, Blake (85), Storms (93).

Mariposa County: It was found in rock seams with danaite at the Josephine mine, Bear Valley, Turner (96).

Napa County: It occurs with smaltite in serpentine and chlorite in the Berryessa Valley.

San Diego County: Erythrite occurs with limonite and morenosite at the Friday mine, in the Julian district, Hudson (22).

ANNABERGITE—Nickel Bloom

Hydrous nickel arsenate, $Ni_3As_2O_8.8H_2O$.

Monoclinic. In capillary crystals and finely fibrous incrustations. Cleavage (010), perfect. Vitreous luster. Color apple-green. H. = 2½ — 3. G. = 3.

Reacts similarly to erythrite, but the borax bead of nickel is brown in the oxidizing flame, and cloudy-gray in the reducing flame.

Coatings of annabergite are an indication of the presence of nickel minerals that have been oxidized, and it is often associated with erythrite.

Lassen County: Annabergite was reported with erythrite and smaltite from this county.

Los Angeles County: It occurs with erythrite and smaltite at the Kelsey mine, San Gabriel Canyon, Storms (93).

Tulare County: The green color of the chrysoprase and chrysopal in the hills east of Porterville is due to nickel, and some coatings of annabergite occur in the region.

SCORODITE

Hydrous ferric arsenate, $FeAsO_4.2H_2O$.

Orthorhombic. Aggregates of small crystals; also earthy. Brittle. Vitreous luster. Color pale leek-green, liver-brown. Streak white. H. = 3½ — 4. G. = 3.1 — 3.3.

A slight coating of arsenic can be obtained on charcoal when scorodite is reduced, and the residue becomes magnetic. The arsenic ring can be obtained by fusing in a closed tube with a splinter of charcoal. Gives water in a closed tube. Soluble in hydrochloric acid.

Inyo County: Scorodite occurred in the Noonday mine, near Tecopa.

Mariposa County: Pale-green crystals of scorodite were found as an alteration product of arsenopyrite associated with pitticite on the

South Fork of Merced River, near the mouth of Devils Gulch, Rogers (12).

San Diego County: It was found massive near Moreno Lake.

STRENGITE

Hydrous iron phosphate, $FePO_4.2H_2O$.

Orthorhombic. Generally in spherical and botryoidal forms. Cleavage (001), perfect. Vitreous luster. Color pale-red. H. = 3 — 4. G. = 2.87.

Fusible. Soluble in hydrochloric acid.

Amador County: Strengite was described by Hulin (30) as occurring in the Kennedy mine.

San Diego County: Strengite occurred with salmonsite in the Stewart mine at Pala, Schaller (12b). It was analyzed by Schaller, Clarke (15).

P_2O_5	CaO	Fe_2O_3	Mn_2O_3	H_2O-	H_2O+	Insol.
37.06	0.34	41.14	2.36	0.17	19.05	tr. = 100.12%

VARISCITE

Hydrous aluminum phosphate, $AlPO_4.2H_2O$.

Orthorhombic. Octahedral habit. Crystalline aggregates and incrustations. Vitreous luster. Color green. H. = 4. G. = 2.54.

Infusible, but whitens when heated. Moistened with cobalt nitrate solution and intensely heated, it becomes blue. Gives water in a closed tube. Phosphate can be precipitated by ammonium molybdate from a nitric acid solution after fusion of the powder with sodium carbonate.

El Dorado County: Variscite was reported to have been found in Pleasant Valley.

PURPURITE

Hydrous iron and manganese phosphate, $(Fe,Mn)_2O_3.P_2O_5.H_2O$.

Orthorhombic. In small irregular masses. Cleavage (001). Satin luster. Color deep-red or purple. H. = 4 — 4½. G. = 3.4.

Similar to vivianite in reactions. Yields a blue-green bead of manganese with sodium carbonate.

San Diego County: Purpurite was found with lithiophilite and triphylite in a pegmatitic dike on Heriart Hill at Pala, Graton and Schaller (05).

SICKLERITE

Hydrous iron, manganese and lithium phosphate, $Fe_2O_3.6MnO.4P_2O_5.3(Li,H)_2O$.

Orthorhombic? In cleavable masses. Color dark-brown. Streak light yellowish-brown. H. = 4. G. = 3.45.

Easily fusible. Soluble in acid.

San Diego County: Sicklerite occurs in cleavable masses, resulting from the alteration of lithiophilite, at the Vanderburg-Naylor mine on Heriart Hill near Pala. It was analyzed and named by Schaller (12b).

MnO	CaO	Fe_2O_3	Mn_2O_3	P_2O_5	H_2O+	Li_2O	Insol.	
33.60	0.20	11.26	2.10	43.10	1.71	3.80	4.18 = 99.95%	G. = 3.45.

SALMONSITE

Hydrous iron and manganese phosphate, $Fe_2O_3.9MnO.4P_2O_5.14H_2O$.

Orthorhombic. Cleavable fibrous masses. Color buff-yellow. H. = 4. G. = 2.88.

Reacts similarly to vivianite, but gives in addition a blue-green bead of manganese with sodium carbonate.

San Diego County: Salmonsite is a buff-yellow alteration product of hureaulite, associated with fibrous palaite and blue strengite, which was discovered in the Stewart mine at Pala. It was described and analyzed by Schaller (12b).

FeO	MnO	CaO	Fe_2O_3	P_2O_5	H_2O+	H_2O-	Insol.	
0.13	37.74	1.06	9.53	34.86	15.30	0.43	1.40 = 100.45%	G. = 2.88.

HUREAULITE

Hydrous manganese phosphate, $H_2Mn_5(PO_4)_4.4H_2O$.

Monoclinic. In groups of short prisms. Massive, compact. Cleavage (100), distinct. Color orange-red, rose, and nearly colorless. H. = 5. G. = 3.18.

Easily fusible. The nitric acid solution gives the phosphate reaction on addition of ammonium molybdate. A blue-green bead of manganese is obtained when hureaulite is fused with sodium carbonate. Yields water in a closed tube. Soluble in acid.

San Diego County: Hureaulite was found in the Stewart mine at Pala and mentioned by Schaller (12b). Analysis by Schaller, Clarke (15).

P_2O_5	FeO	MnO	CaO	Fe_2O_3	H_2O+	Li_2O	Insol.	
38.63	6.14	39.29	1.08	0.99	12.46	tr.	1.58 = 100.17%	G. = 3.13

VOLBORTHITE

Hydrous copper, barium and calcium vanadate, $6(Cu,Ba,Ca)O.V_2O_5.15H_2O$.

Monoclinic? Small plates in globular aggregations. Pearly to vitreous luster. Color olive-green, citron-yellow. Streak yellowish-green. H. = 3. G. = 3.5.

A small amount of metallic copper can be obtained by reduction on charcoal, using sodium carbonate flux. Ammonia added to a nitric acid solution will show the color of copper. Dilute sulphuric acid added to solution will precipitate barium sulphate. The green bead of vanadium can be obtained with phosphorous salt. Water is given off in a closed tube.

Glenn County: Volborthite was reported to have been found at the Mammoth Copper mine on Grindstone Creek.

TURQUOIS

Hydrous aluminum and copper phosphate, $H_5(CuOH)[Al(OH)_2]_6(PO_4)_4$.

Triclinic. Massive. In thin seams and incrustations. Waxy luster. Color sky-blue, bluish-green, apple-green. Streak white or greenish. H. = 5 — 6. G. = 2.6 — 2.83.

Infusible and becomes brown or black when heated. After fusion with sodium carbonate and dissolving in nitric acid, the phosphate reaction is obtained on addition of ammonium molybdate to solution. Gives water in a closed tube. Soluble in hydrochloric acid.

Madera County: A specimen of turquois from the Taylor ranch, having a hexagonal form, was described as a pseudomorph after apatite, Moore and von Zepharovich (85).

San Bernardino County: Apple-green turquois has been found near Victor. Turquois was early mined from a deposit in the high mountains north of Ivanpah, Kunz (05). Considerable light-green gem material has been obtained from this district. It occurs in a coarse porphyritic granite and in porphyry dikes near the head of Riggs Wash, 12 miles northeast of Silver Lake. Turquois has been found in the Solo mining district, 30 miles northwest of Cima. Turquois has been found in a black matrix at Goldstone Camp, about 30 miles north of Barstow.

AUGELITE

Hydrous aluminum phosphate, $2Al_2O_3.P_2O_5.3H_2O$.

Monoclinic. In tabular crystals and massive. Cleavages, (110) and ($\bar{1}01$). Luster vitreous, pearly on cleavage surfaces. Colorless to white. H. = 5. G. = 2.5 — 2.7.

B. B. infusible. Little affected by acids. Yields much water in a closed tube.

Mono County: Augelite occurs with andalusite, lazulite, alunite, and pyrophyllite at the mine of Champion Sillimanite, Incorporated, on the western slope of the White Mountains, 7 miles east of Mocalno, Lemmon (35).

LIROCONITE

Hydrous aluminum and copper arsenate.

Monoclinic. Thin tabular crystals. Vitreous luster. Color and streak sky-blue to verdigris-green. H. = 2 — 2½. G. = 2.88 — 2.98.

Fusible. Can be reduced to metallic copper on charcoal with sodium carbonate flux, and yields a slight coating of arsenic. Ammonia added to a nitric acid solution will precipitate flocculent aluminum hydroxide, while the solution becomes blue. Gives water in a closed tube and also an arsenical mirror when vapors are reduced by a splinter of charcoal. Soluble in nitric acid.

Inyo County: Liroconite was found at the old Cerro Gordo mine associated with other rare copper minerals.

AUTUNITE

Hydrous uranium and calcium phosphate, $CaO.2UO_3.P_2O_5.8H_2O$.

Orthorhombic. In thin tabular crystals; also foliated, micaceous. Cleavage perfect basal. Brittle. Luster pearly, subadamantine. Color lemon-yellow. Streak yellow. H. = 2 — 2½. G. = 3.1.

Fuses easily to a black mass giving a pale-greenish flame. Gives green bead with phosphorous salt. Soluble in nitric acid.

Kern County: Autunite has been found in the Summit Diggings, near Randsburg.

San Bernardino County: Specimens of yellow autunite associated with green plates of torbernite have come from the northeastern part of the county.

BINDHEIMITE

Hydrous lead antimonate.

Amorphous. Lamellar, massive, incrustations. Resinous luster. Color gray, brown, white. H. = 4. G. = 4.6 — 4.76.

Fusible. Easily reduced on charcoal to a brittle white metallic globule of antimony and lead, and yields a white and yellow coating of

the mixed oxides. A white antimony oxide coating can be obtained in an open tube. Gives water in a closed tube.

Bindheimite is very widely distributed in oxidized ores, probably occurring wherever antimonial sulpho-salts have been subjected to weathering, Shannon (20b).

Fresno County: Brown bindheimite has come from this county.

Inyo County: Bindheimite was reported to have been found at the Union and Modoc mines, Hanks (84). Murphy (30a) has reported the occurrence of bindheimite in the oxidized ores of the Panamint district.

San Bernardino County: It was found with wulfenite, vanadinite, and descloizite at Camp Signal, near Goffs. Bindheimite from this county has been analyzed by Shannon (20b).

PbO	Sb_2O_5	Fe_2O_3	H_2O_3	Insol.
40.53	44.28	3.28	5.04	2.93 = 96.06%

DIADOCHITE

$2Fe_2O_3.3(SO_3,P_2O_5).15H_2O$.

Amorphous. Massive. Vitreous. Yellow-brown. H. = 3. G. = 2.0.

San Benito County: Diadochite has been found in the New Idria quicksilver mine, Rogers (38a).

PITTICITE

Hydrated arsenate and sulphate of ferric iron.

Amorphous. Massive and reniform. Conchoidal fracture. Vitreous luster. Color yellowish and reddish-brown. H. = 2 — 3. G. = 2.2 — 2.5.

Easily fusible. Becomes magnetic on heating. Barium chloride added to the hydrochloric acid solution precipitates barium sulphate. Gives water and the arsenic mirror in a closed tube. Soluble in hydrochloric acid.

Mariposa County: Dark-brown amorphous pitticite resembling limonite was found with the scorodite as an alteration product of arsenopyrite on the South Fork of Merced River, near the mouth of Devils Gulch, Rogers (12).

HYDROCARBONS

Napalite	Curtisite	Ionite
Aragotite	Amber	Posepnyte

NAPALITE

A hydrocarbon, C_3H_4.

Dark reddish-brown bituminous substance found with cinnabar. Brittle. Resinous luster. H. = 2. G. = 1.02.

Napa County: Napalite occurred with pyrite and millerite at the old Phoenix cinnabar mine, Pope Valley, and was described by Becker (88), with analyses by Melville.

C	H
89.84	10.17 = 100.01%
89.54	10.36 = 99.90%
89.35	10.11 = 99.46%

ARAGOTITE

A hydrocarbon.

Bright scales. Transparent. Color honey-yellow. Streak white. H. = 1. G. = 1.1.

Volatile.

This material, no longer recognized by Dana as a mineral species, has been reported from several cinnabar mines.

Napa County: Aragotite occurred on cinnabar at the Redington mine, Knoxville, Durand (73). A small quantity of it was found in the Ætna quicksilver mine, 400 feet below the surface. Hanks (05) has communicated a partial analysis of aragotite from this locality:

C	H
88.10	9.17 = 97.27%

Santa Clara County: It was first observed at the New Almaden mine impregnating siliceous dolomite and was described by Durand (73).

CURTISITE

A hydrocarbon, $C_{24}H_{18}$.

Probably orthorhombic. Granular. Perfect basal cleavage. Fracture conchoidal. Luster vitreous to adamantine. Color yellow to pistachio green. H. = less than 2. G. = 1.235 — 1.237.

Inflammable.

Lake County: Curtisite occurs with cinnabar and dolomite in serpentine at the Mirabel mine, near Middletown.

San Francisco County: Curtisite occurs in a ledge of serpentine veined with chalcedony at Duboce St., near Market St., in San Francisco.

Sonoma County: Curtisite was found with realgar, metacinnabar, and opal at Skaggs Springs. It was described and named by Wright and Allen (30), with analysis by Wright.

C	H	Residue
93.91	5.57	1.35 = 100.83%

AMBER

An oxygenated hydrocarbon.

In irregular masses, with conchoidal fracture. Transparent to translucent. Luster resinous. Color yellow, sometimes reddish or brownish. H. = 2 — 2½. G. = 1.096.

Easily fusible.

Ventura County: The occurrence of amber in Eocene beds on the northeast side of the Simi Valley has been described by Murdoch (34).

IONITE

A hydrocarbon containing about 50% water.

Earthy. Color brownish-yellow. G. = 0.90.

Amador County: Ionite was found in an argillaceous lignite in thin seams in Ione Valley and described by Purnell (78).

POSEPNYTE

An oxygenated hydrocarbon.

In hard brittle plates or nodules. Color light-green and brown.

Lake County: Posepnyte was found at the Great Western mine and was described and named by von Schröckinger (77), with analyses by Dietrich. Part was soluble in ether, and part insoluble, the latter corresponding to ozocerite. Becker (88) gives an analysis by Melville of similar material.

	Sol.			Insol.			
	C	H	O	C	H	O	Ash
von Schröckinger	71.84	9.95	18.21	84.27	11.74	3.99	
Melville	---	---	---	85.60	10.71	3.22	0.47

SILICATES

Feldspars
- Orthoclase
- Celsian
- Microcline
- Albite
- Oligoclase
- Andesine
- Labradorite
- Anorthite

Pollucite
Lazurite
Scapolite

Zeolites
- Clinoptilolite
- Heulandite
- Stilbite
- Phillipsite
- Chabazite
- Thomsonite
- Gonnardite
- Natrolite
- Mesolite
- Scolecite
- Analcime
- Laumontite

Cordierite

Pyrophyllite
Anauxite
Kaolinite
Halloysite
Allophane
Chloropal
Beidellite
Montmorillonite
Talc
Sepiolite
Garnierite
Deweylite
Neotocite
Celadonite
Custerite
Centrallasite
Gyrolite
Bementite
Apophyllite
Okenite
Gillespite
Sanbornite

Chlorites
- Penninite
- Clinochlore
- Prochlorite
- Jefferisite
- Iddingsite

Saponite
Griffithite
Stilpnomelane

Brittle Micas
- Margarite
- Xanthophyllite
- Chloritoid

Prehnite

Micas
- Muscovite
- Mariposite
- Roscoelite
- Biotite
- Phlogopite
- Lepidolite

Glauconite
Cookeite
Ganophyllite

Amphibole Group
- Anthophyllite
- Amphibole
  - Cummingtonite
  - Tremolite
  - Actinolite
  - Hornblende
- Soda Amphiboles
  - Glaucophane
  - Riebeckite

Serpentine

Pyroxene Group
- Enstatite
- Hypersthene
- Pyroxene
  - Diopside
  - Hedenbergite
  - Augite
- Acmite
- Spodumene
- Rhodonite

Wollastonite
Pectolite

Neptunite
Joaquinite
Xonotlite
Inesite
Foshagite
Riversideite
Jurupaite
Crestmoreite
Chrysocolla
Searlesite
Bavenite
Benitoite
Tourmaline
Beryl
Gehlenite
Hemimorphite
Lawsonite

Olivine Group
- Olivine
- Fayalite
- Tephroite
- Monticellite

Merwinite
Willemite
Chondrodite

Garnet Group
- Grossularite
- Pyrope
- Almandite
- Andradite
- Spessartite
- Uvarovite

Plazolite
Idocrase

Epidote Group
- Zoisite
- Epidote
- Piedmontite
- Allanite

Pumpellyite
Zircon
Datolite
Topaz
Axinite
Ilvaite
Andalusite
Sillimanite
Kyanite
Staurolite
Sphene
Dumortierite
Thaumasite
Spurrite
Tilleyite

FELDSPARS

The name feldspar is given to a group of silicates of aluminum and sodium, calcium, potassium, or barium similar in hardness, cleavage, specific gravity, and twinning. They include: the potash feldspars, *orthoclase* and *microline;* the soda feldspar, *albite;* the lime-feldspar, *anorthite;* the feldspars intermediate between albite and anorthite, namely *oligoclase, andesine,* and *labradorite;* and the barium feldspar, *celsian.*

Feldspars are the most abundant and important of rock-forming silicates, and the classification of igneous rocks depends partly upon their prevailing feldspar. The albite-anorthite feldspars are commonly called the plagioclase feldspars, and in many petrographic descriptions this name is used, so that the particular kind of feldspar is not designated. As rock-forming minerals, the feldspars are too widely distributed to list all localities.

ORTHOCLASE

Potassium and aluminum silicate, $KAlSi_3O_8$.

Monoclinic. Crystals prismatic, very common; often as Carlsbad twins. Massive or compact. Perfect basal and clinopinacoidal cleavage. Brittle. Vitreous luster. Colorless, white, pale-yellow, flesh-red. Streak uncolored. H. = 6. G. = 2.54 — 2.57.

Fused at 5 in the scale of fusibility, therefore can only be rounded on edges of splinter. Insoluble in acids. The powder mixed with gypsum, taken on the loop of a platinum wire and held in the colorless flame of a Bunsen burner, will give the violet flame of potassium, best seen through blue glass or the Merwin color screen.

Orthoclase is an essential constituent of many igneous rocks, granites, syenites, quartz-porphyries, rhyolites, and trachytes. Large crystals often form the phenocrysts of porphyritic rocks, and these crystals are often Carlsbad twins. The color of granites is mainly due to the color of the orthoclase, red granites having orthoclase colored by ferric oxide. Granites, syenites, and diorites are often intersected by pegmatite veins consisting of coarse crystals and massive orthoclase, with quartz and mica, and these veins vary greatly in width; some can be quarried for the feldspar.

Adularia is a glassy, transparent variety, sometimes found in large crystals.

Valencianite is a variety name given to vein orthoclase.

Perthite is an intergrowth of orthoclase or microcline and albite. It is an important constituent of some granites and pegmatites.

CELSIAN

Barium and aluminum silicate, $BaAl_2Si_2O_8$.

Monoclinic. Usually massive. Cleavage and twinning like orthoclase. Vitreous luster. Colorless. H. = 6 — 6½. G. = 3.37.

Distinguished from other feldspars by greater density or test for barium.

Celsian is not so common as the other feldspars and has been reported from only one locality in this State.

MICROCLINE

Potassium and aluminum silicate, $KAlSi_3O_8$.

Triclinic. Crystals very common. Bases often show rectangular grating structure. Massive or compact. Cleavage like orthoclase. Brittle. Vitreous, sometimes pearly. Color white to pale cream-yellow, red, green. H. = 6 — 6½. G. = 2.54 — 2.57.

Same reactions as for orthoclase.

Microcline has the same composition as orthoclase, but differs from it in its twinning structure and crystallization. It is a constituent of some granites and pegmatites.

ALBITE

Sodium and aluminum silicate, $NaAlSi_3O_8$.

Triclinic. Crystals tabular and elongated, common as repeated twins. Often massive. Cleavage perfect basal and brachypinacoidal. Brittle. Vitreous luster. Often very glassy. Colorless and white. Streak uncolored. H. = 6 — 6½. G. = 2.61 — 2.62.

Fuses at 4 and imparts a bright yellow color to flame. Insoluble in acid.

Albite is a common constituent of acid granites, acid rhyolites, granodiorites, and diorites; also metamorphic gneisses and schists. It forms very prominent white veins in the crystalline schists of the Coast Ranges and the Sierra Nevada.

OLIGOCLASE

Sodium, calcium and aluminum silicate, $m NaAlSi_3O_8$ with $n CaAl_2Si_2O_8$, nearer albite in composition.

Triclinic. Crystals, usually twinned like albite. Commonly massive or compact. Cleavage perfect basal and brachypinacoidal. Brittle. Colorless to white. Streak uncolored. H. = 6 — 6½. G. = 2.63 — 2.65.

Same reactions as albite. The calcium can be determined in the wet way, by precipitation as calcium oxalate. All insoluble silicates need to be fused with sodium carbonate to render them soluble.

Oligoclase is a constituent of granodiorites, diorites, porphyrites, and andesites. It is occasionally found in large white masses as veins in diorite and other basic rocks.

ANDESINE

Sodium, calcium, and aluminum silicate, $m NaAlSi_3O_8$ with $n CaAl_2Si_2O_8$, intermediate between albite and anorthite.

Triclinic. Crystals similar to albite. Commonly massive or compact. Cleavages as in albite. Colorless. H. = 5 —6. G. = 2.66 — 2.68.

Same reactions as for oligoclase.

Andesine is a constituent of diorite, gabbro, andesite, and related rocks.

LABRADORITE

Calcium, sodium and aluminum silicate, $m CaAl_2Si_2O_8$ with $n NaAlSi_3O_8$, nearer anorthite in composition.

Triclinic. Small twinned crystals in rocks; sometimes massive with twinning striations. Properties like oligoclase. H. = 5 —6. G. = 2.69 — 2.71.

Same reactions as for oligoclase. Slightly acted on by hydrochloric acid.

Labradorite is an essential constituent of most basic igneous rocks such as gabbros, diabases, and basalts. It also occurs as veins.

ANORTHITE

Calcium and aluminum silicate, $CaAl_2Si_2O_8$.

Triclinic. Generally in small crystals as a rock constituent. Properties like oligoclase and labradorite. H. = 6. G. = 2.74 — 2.76.

Fuses at 5. Soluble slowly and yields gelatinous silica. Gives the red flame of calcium.

Anorthite is a constituent of the very basic igneous rocks.

FELDSPAR LOCALITIES

Only some of the more conspicuous or notable occurrences of the feldspars are cited below.

Alameda County: Good crystals of glassy albite with yellow euhedral quartz occur at the Newman mine on Cedar Mountain.

Calaveras County: Large crystals of orthoclase occur at Mokelumne Hill. Albite is a common constituent of the schists of the Mother Lode. Crystals of albite from the old Stanislaus mine on Carson Hill, had the forms: (010), (001), $(\bar{1}11)$, $(\bar{1}01)$, $(1\bar{1}0)$, $(\bar{1}30)$, and (021), Jackson (86). Crystals from Angels Camp had the forms: (010), (110), $(1\bar{1}0)$, (111), $(\bar{1}\bar{1}1)$, and (001); analyzed by Genth (59).

SiO_2	Al_2O_3	Fe_2O_3	CaO	Na_2O	K_2O	H_2O
68.39	19.65	0.41	0.47	10.97	tr.	0.21 = 100.10%

Valencianite occurs 5 miles east of Milton in small prismatic crystals. Forms: (160), $(10\bar{1})$, (001), and (010), Rogers (12).

Contra Costa County: Albite is a common constituent of the chlorite and actinolite-schists of the county. Numerous white veins of albite intersect these schists. It was prominent as veins in the actinolite schist near San Pablo; analyzed by Blasdale (01).

				H_2O	
SiO_2	Al_2O_3	CaO	Na_2O	at 100°	ab. 100°
67.09	20.47	0.24	10.96	0.27	0.59 = 99.62%

El Dorado County: Large white crystals of orthoclase with bornite, molybdenite, epidote, and axinite occurred at the old Cosumnes copper mine, near Fairplay. Massive red orthoclase occurs with tourmaline at Bucks Bar, Cosumnes River. Small colorless crystals of adularia have been found on the south side of Fallen Leaf Lake with forms (110), $(\bar{1}01)$, (001), and (010). They are associated with pale-green diopside, Rogers (12). Albite with siderite and calcite occurs at the Red Hill mine in the Kelsey district.

Fresno County: Bodies of feldspathic rock, mainly orthoclase, as pegmatites, occur 5 miles northeast of Trimmer.

Humboldt County: Glassy crystals of albite are common as veins in the schist of Horse Mountain.

Inyo County: White argentiferous orthoclase occurred at the White Lime mine in the Deep Spring district. Glassy adularia was found in good crystals at Rialto in the Funeral Mountains. Pink perthite occurs 6 miles east of Tecopa.

Kern County: White orthoclase was reported from the Long Tom mine. Albite in schists occurs near Randsburg and Johannesburg. A massive flesh-red orthoclase occurs near Rosamond.

Lake County: Anorthite showing fine cleavage occurs in nodules in serpentine, 2 miles northeast of Middletown along the highway to Lower Lake.

Los Angeles County: Albite is common in the schists on Santa Catalina Island. Crystals showing the forms (110), ($1\bar{1}0$), (101), and (001) are thickly scattered through a chlorite schist at the western tip of the island, Woodford (24). Anorthosite, the plutonic rock which forms a large part of the western San Gabriel Mountains, consists largely of andesine, W. J. Miller (31).

Madera County: Massive white orthoclase is found near Hildreth.

Marin County: Albite veins are common in the schists of the county. Crystals from the lawsonite schist at Reed Station have the forms: (001), (010), (100), (021), ($0\bar{2}1$), ($\bar{1}01$), ($\bar{2}01$), (150), (130), ($\bar{1}11$), ($\bar{1}\bar{1}1$), ($\bar{1}12$), ($\bar{1}\bar{3}1$), ($\bar{2}21$), (120), (350), (110), ($1\bar{1}0$), ($1\bar{3}0$), ($\bar{1}\bar{1}2$), ($\bar{2}\bar{2}1$), ($\bar{2}\bar{4}1$), and ($\bar{3}12$), Schaller (11).

Mariposa County: Large crystals of orthoclase showing Baveno twinning are abundant in a pegmatite dike near the head of Yosemite Falls. Orthoclase showing Carlsbad twinning is conspicuous as phenocrysts in the granite of the Cathedral Range. Celsian occurs with sanbornite and gillespite 1 mile north of Trumbull Peak, near Incline, Rogers (32a).

Modoc County: Pink orthoclase occurs in a pegmatite near Susanville. Pebbles of labradorite from this county were found containing small opaque inclusions of native copper, making them aventurine labradorite, Andersen (17).

Mono County: Orthoclase is found in pegmatitic veins in the Blind Spring Hill district.

Monterey County: Large phenocrysts of orthoclase occur in the porphyritic rock at Pacific Grove and Cypress Point. Massive cream-

colored orthoclase from the Jens quarry, 4 miles east of Chualar, occurs at contact between limestone and granite, and was analyzed by E. W. Rice:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Loss
65.66	21.34	0.40	1.50	tr.	11.85	0.48 = 101.23%

Plumas County: Albite is a constituent of the syenite of Spanish Peak, Murgoci (06). Oligoclase was described by Lawson (03) as a constituent of plumasite from Spanish Peak, and was analyzed by Newfield.

SiO_2	Al_2O_3	CaO	Na_2O	H_2O
61.36	22.97	5.38	8.08	1.72 = 99.51%

Riverside County: An outcrop of orthoclase and quartz occurs in the granite hills 4 miles south of Lakeview; orthoclase and quartz also occurs on the Warren ranch 3 miles east of Lakeview. Massive quartz and feldspar occur 3½ miles northeast of Murrieta. Orthoclase feldspar occurs near Nuevo. White orthoclase from a pegmatite at Crestmore has been analyzed by Eakle (17).

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O	K_2O	Ign.
64.54	20.86	tr.	1.86	tr.	1.18	11.85	0.52 = 100.81%
							G. = 2.54.

San Benito County: Albite occurs in grayish and greenish, minute twinned crystals in the rock surrounding the veins of natrolite containing benitoite and neptunite near the headwaters of the San Benito River. Forms: (001), (010), (110), $(1\bar{1}0)$, $(1\bar{2}0)$, (130), $(1\bar{3}0)$, $(\bar{1}01)$, $(1\bar{1}1)$, $(\bar{1}\bar{1}1)$, $(\bar{1}\bar{1}2)$, $(\bar{1}\bar{3}1)$, and $(\bar{2}\bar{2}1)$, Louderback (09).

San Bernardino County: Veins of orthoclase occur in the mountains in the northeastern part of the county. Massive red orthoclase occurs near Manvel. Giant crystals of orthoclase, some of them Carlsbad twins, are abundant in granite-porphyry dikes 1½ miles southwest of Twenty-nine Palms. Orthoclase is a constituent of pegmatite dikes intersecting granite 1½ miles south of Oro Grande. It occurs 3½ miles north of Hinkley Station.

San Diego County: Albite was mentioned as a constituent of some of the rocks of the county by Kroustchoff (85) and analyzed by him.

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	Ign.
65.17	tr.	21.14	0.74	1.20	0.04	1.70	9.20	0.80 = 99.99%

The gem-bearing pegmatite veins near Pala, Mesa Grande, Rincon, and Ramona consist largely of albite, orthoclase, and microcline. Coarse crystals of the feldspars occur in these veins showing Carlsbad, Baveno, and albite twinning structure. Crystals of albite at the Vic-

tor mine, Rincon, occur tabular to (010) with forms (010), (001), (110), ($1\bar{1}0$), ($\bar{1}30$), ($1\bar{3}0$), ($\bar{1}01$), ($\bar{2}01$), ($\bar{1}11$), and ($\bar{1}\bar{1}1$), Rogers (10). Manganiferous albite from the Caterina mine at Heriart Mountain, near Pala, has been analyzed by Kraus and Hunt (15).

SiO_2	Al_2O_3	Fe_2O_3	MnO	CaO	MgO	Na_2O	K_2O	H_2O
64.44	20.28	0.98	1.71	1.76	0.11	9.83	0.49	0.96 = 100.56%

Anorthite from the San Marcos gabbro on the summit ridge of Pala Mountain has been described by F. S. Miller (35), and analyzed by Gonyer.

SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	Na_2O	K_2O	H_2O
43.77	36.11	0.09	0.07	18.73	0.67	0.11	0.40 = 99.95%

Anorthite is a constituent of the orbicular gabbro at Dehesa and was analyzed by Schaller, Lawson (04).

SiO_2	Al_2O_3	CaO	Na_2O
44.39	36.55	18.55	0.83 = 100.32%

A large outcrop of feldspar and quartz occurs near Morena Dam, about 5 miles north of Campo. Outcrops of orthoclase and quartz occur 5 miles west of Alpine. Good massive orthoclase is found near Mesa Grande, Campo, and Lakeside. Orthoclase and albite occur as pegmatite veins containing columbite, cassiterite, and blue tourmaline, in the Chihuahua Valley.

Santa Barbara County: Labradorite is a constituent of the teschenites at Point Sal, and was analyzed by Fairbanks (96).

SiO_2	Al_2O_3	CaO	Na_2O	K_2O	Ign.
52.72	30.46	11.01	3.70	0.42	1.44 = 99.75%

Santa Clara County: Oligoclase is a constituent of the glaucophane rocks of this county, Murgoci (06).

Shasta County: Veins of orthoclase occur on Tom Neal Mountain. Good crystals of andesine occur in dikes of andesite porphyry in Jones Valley, 15 miles northeast of Redding. Good crystals of orthoclase occur in dikes of soda granite-porphyry on Salt Creek, along the highway between Baird and Antler.

Tulare County: Large crystals of oligoclase, formed as a replacement of microcline, have been described by Rogers (31b) from a pegmatite at Salt Creek.

Tuolumne County: Large crystals of orthoclase are found on Sullivan Creek.

POLLUCITE

Hydrous caesium aluminum silicate, $2Cs_2O.2Al_2O_3.9SiO_2.H_2O$.

Isometric. In cubic crystals; also massive. Colorless. H. = 6½. G. = 2.901.

Difficultly fusible. Decomposed by acid.

San Diego County: Massive pollucite occurs in small amounts in the gem-bearing pegmatites near Pala and Mesa Grande.

LAZURITE—Lapis-Lazuli

Sodium and aluminum silicate, with sodium sulphide, $3NaAlSiO_4.Na_2S$.

Isometric. In cubes and dodecahedrons. Massive. Vitreous luster. Color azure-blue, violet-blue. H. = 5 — 5½. G. = 2.38 — 2.45.

Fuses with intumescence. Soluble in hydrochloric acid and yields gelatinous silica on evaporation.

Madera County: Lazurite is reported to have been found in the Minaret Mountains.

San Bernardino County: Small boulders of limestone containing lapis-lazuli with pyrite occur in the bed of San Antonio Creek, near Upland. The boulders come from an old prospect which was thought to be a silver deposit. It occurs on the northern slope of the South Fork of Cascade Canyon, 1½ miles east of the Hogback in San Antonio Canyon, 12 miles from Upland. The occurrence has been described as lapis-lazuli by Surr (13), who erroneously stated the locality to be in Los Angeles County. Rogers, (12, 38), has made a qualitative examination of the composition of this material which indicates that it is a sulphide-bearing haüyne.

SCAPOLITE—Wernerite

Scapolite is the name given to a group of rock-forming silicates consisting of isomorphous mixtures of *marialite,* $3NaAlSi_3O_8.NaCl$ and *meionite,* $3CaAl_2Si_2O_8.CaCO_3$.

Tetragonal. Usually massive granular. Brittle. Luster vitreous to pearly. Color white, gray, or pink. Streak uncolored. H. = 5 — 6. Marialite, G. = 2.63; Meionite, G. = 2.72.

Fuses easily with slight intumescence to a white blebby glass. A yellow sodium flame is usually obtained. Marialite is only slightly attacked by acids, whereas meionite is easily decomposed.

The scapolites are in general formed by contact metamorphism.

Nevada County: Scapolite occurs in a contact schist at Nevada City and Grass Valley, Lindgren (96).

Riverside County: Scapolite occurs with green pyroxene, quartz, feldspar, wollastonite, and grossularite garnet at Crestmore, Eakle (17). It occurs in small dikes with augite on the Eagle Mountains.

Tulare County: Scapolite occurs in a metamorphic rock with wollastonite, calcite, and diopside southwest of Three Rivers in the S½ Sec. 25, T. 17 S., R. 28 E., M. D. M.

ZEOLITES

The zeolites are hydrous aluminum silicates of sodium, potassium, and calcium. They have certain features of crystal structure, chemical behaviour and occurrence in common. They are rather easily attacked by acids and lose water readily.

CLINOPTILOLITE

Hydrous calcium, sodium, potassium, and aluminum silicate, $(Ca,Na_2,K_2)O.Al_2O_3 10SiO_2.7H_2O$.

San Luis Obispo County: Clinoptilolite was reported as a constituent of altered fragmental volcanic rocks of Miocene age by Bramlette and Posnjak (33). Analysis by Fairchild:

SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	Na_2O	K_2O	H_2O —	H_2O +
64.30	12.78	0.82	0.62	2.42	3.96	1.36	4.78	9.50 = 100.54%

HEULANDITE

Hydrous calcium sodium, and aluminum silicate, $(Ca,Na_2)O.Al_2O_3.6SiO_2.5H_2O$.

Monoclinic. In platy crystals. Perfect clinopinacoidal cleavage. Brittle. Luster pearly and vitreous. Color white, red, brown. Streak white. H. = 3½ — 4. G. = 2.18 — 2.22.

Intumesces or boils when fused. Soluble in hydrochloric acid, without gelatinization. Gives water in a closed tube.

Heulandite is a zeolite usually formed as a secondary mineral in cavities and seams of basic volcanic rock, with stilbite, chabazite, and other zeolites.

Plumas County: Heulandite occurs at Engels in druses of pegmatites, Graton and McLaughlin (17).

San Diego County: It occurs sparingly as pale-brown crystals with stilbite at Rincon. Forms: (010), (001), (201), ($\bar{2}$01), and (110), Rogers (10).

STILBITE

Hydrous sodium, calcium, and aluminum silicate, $(Na_2Ca)Al_2Si_6O_{16}.6H_2O$.

Monoclinic. Commonly in sheaf-like aggregates, lamellar. Cleavage perfect clinopinacoidal. Brittle. Vitreous to pearly luster. Color white, yellowish-brown. Streak uncolored. H. = 3½ — 4. G. = 2.09 — 2.20.

Fuses with exfoliation. Gives water in a closed tube. Soluble in hydrochloric acid without gelatinizing.

Stilbite is a common zeolite occurring usually as sheaf-like aggregates in cavities and seams of volcanic rock.

Modoc County: Specimens of lava with amygdules filled with stilbite and natrolite have come from this county.

Plumas County: White and brown stilbite occurs with chabazite and natrolite in the cavities of basic rock at Engels.

San Diego County: It occurs as sheaf-like aggregates of small brown crystals at the Victor mine near Rincon, Rogers (10), and occasionally in some of the gem-bearing pegmatites at Pala.

Santa Barbara County: It was found in the San Pablo Mountains of Santa Rosa Island.

Tulare County: It occurs in volcanic rock at Mount Kaweah.

PHILLIPSITE

Hydrous potassium, calcium, and aluminum silicate, $(K_2,Ca)Al_2Si_4O_{12}.4\frac{1}{2}H_2O$.

Monoclinic. Usually in groups of twinned crystals. Cleavage (001) and (010) rather distinct. Brittle. Vitreous luster. Color white to red. Streak uncolored. Translucent to opaque. H. = 4 — 4½. G. = 2.2.

Fuses easily to a white enamel. Gelatinizes with hydrochloric acid.

Plumas County: Phillipsite is one of the zeolites at the Engels mine.

CHABAZITE

Hydrous calcium, sodium, and aluminum silicate, $(Ca,Na_2)Al_2Si_4O_{12}.6H_2O$.

Hexagonal-rhombohedral. Crystals nearly cubic. Cleavage $(10\bar{1}1)$ distinct. Brittle. Vitreous luster. Color white, flesh-red. Streak uncolored. H. = 4 — 5. G. = 2.08 — 2.16.

Fuses with light swelling. Decomposed by hydrochloric acid, but without gelatinization. Gives much water in a closed tube.

Chabazite is a zeolite occurring as a secondary mineral in cavities of basic volcanic rock.

Mono County: Minute crystals of chabazite have been found in cracks in schist near the head of McGee Creek, just north of Mount Crocker.

Nevada County: It occurs in colorless crystals with epidote and pyrite at the Star placer mine, Grass Valley, Lindgren (96).

Plumas County: It was found as rhombohedrons in olivine basalt at the Dodson mine, Mooreville Ridge, Turner (94a). Chabazite occurred at the Engels mine, Graton and McLaughlin (17).

Shasta County: It was found with natrolite and tridymite in the basalts near Round Mountain, Melhase (34).

THOMSONITE

Hydrous sodium, calcium, and aluminum silicate, $(Na_2,Ca)Al_2Si_2O_8.2\frac{1}{2}H_2O$.

Orthorhombic. Usually radiate fibrous in spherical forms; also compact. Cleavage perfect basal. Brittle. Vitreous luster. Color snow-white to brown. Streak uncolored. H. = 5 — 5½. G. = 2.3 — 2.4.

Fuses very easily to a white enamel. Gelatinizes with hydrochloric acid.

Colusa County: Thomsonite occurs with calcite, pectolite, datolite, prehnite, and hydromagnesite as veins in serpentine in a road quarry, near Wilbur Springs, about 2 miles east of the Lake County line.

Plumas County: Thomsonite has been found at the Engels mine.

GONNARDITE

Hydrous calcium, sodium, and aluminum silicate, $(Ca,Na_2)_2Al_2Si_5O_{15}.5\frac{1}{2}H_2O$.

Orthorhombic. Fibrous, radiating. Silky luster. Color white. H. = $4\frac{1}{2}$ — 5. G. = 2.3.

Easily fusible.

Riverside County: Gonnardite has been found with wollastonite and pyrite in the Commercial quarry at Crestmore.

NATROLITE

Hydrous sodium and aluminum silicate, $Na_2Al_2Si_3O_{10}.2H_2O$.

Orthorhombic. Prismatic crystals. Long needles, columnar, fibrous, radiating, massive. Cleavage perfect prismatic. Vitreous luster. Colorless to white. H. = 5 — $5\frac{1}{2}$. G. = 2.20 — 2.25.

Fuses quietly to a clear glass and gives the yellow flame of sodium. Soluble in hydrochloric acid and yields much jelly on evaporation. Gives water in a closed tube.

Natrolite is a zeolite formed as a secondary mineral in cavities of igneous rock and sometimes as veins in such rock. It usually occurs fibrous or acicular, associated with stilbite and other zeolites.

Alameda County: Needles of natrolite occur with analcite in the amygdules of the andesitic rock on the Berkeley Hills.

Inyo County: Foshag (24a) reports the occurrence of natrolite in radiating groups with analcite in cavities in lava near the Russell borax mine.

Kern County: Fibrous bunches of natrolite occur with analcite in small cavities in a lava flow at Red Rock Canyon.

Modoc County: Slender needles of natrolite occur with stilbite in the lava of this county.

Plumas County: It occurs in druses of pegmatite at Engels.

San Benito County: A large vein of white natrolite occurs near the headwaters of the San Benito River on the west side of the Diablo Range about 25 miles north of Coalinga, in which crystals of benitoite and neptunite are included. The natrolite is mostly granular, although some crystals with the forms (110) and (111) occur. The occurrence has been described by Louderback (07), (09) with analysis by Blasdale.

SiO_2	Al_2O_3	Na_2O	H_2O
47.69	27.14	15.74	9.56 = 100.13%

Shasta County: Natrolite occurs with chabazite and tridymite in basalt near Round Mountain, Melhase (34).

Sierra County: It was found on Herkin's ranch, north of Sierra.

Sonoma County: It occurs in the rocks of the Sonoma Mountains, near Petaluma.

MESOLITE

Hydrous sodium, calcium, and aluminum silicate, $mNa_2Al_2Si_3O_{10}.2H_2O$ $nCaAl_2Si_3O_{10}.3H_2O$.

Monoclinic. Acicular and capillary crystals. Generally silky fibrous crusts. Cleavage perfect prismatic and basal. Vitreous to silky luster. White or colorless. H. = 5. G. = 2.2 — 2.4.

Fuses with intumescence to a white vesicular glass. Soluble with gelatinization. Gives much water in a closed tube.

Mesolite is a zeolite generally occurring as silky fibrous crusts in cavities of basaltic rock.

Lassen County: Mesolite was observed in the lava of Lassen Peak.

Shasta County: It was found near Redding.

Ventura County: It was observed in the basalt of the Pinos Mountains. Tufts of capillary snow-white mesolite occur lining the hollow amygdules of the lavas of Lockwood Valley.

SCOLECITE

Hydrous calcium and aluminum silicate, $CaAl_2Si_3O_{10}.3H_2O$.

Monoclinic. Crystals slender prismatic; also massive, and fibrous. Cleavage nearly perfect prismatic. Vitreous luster, silky when fibrous. Color white. H. = 5 — 5½. G. = 2.16 — 2.4.

B. B. curls up and fuses to a white enamel. Gelatinizes with acids.

Scolecite is a zeolite formed as a secondary mineral in cavities of igneous rock and sometimes as veins in such rock.

Plumas County: It occurs as a hydrothermal mineral in small veinlets of finely radial white fibers at the Engels mine, Graton and McLaughlin (17).

ANALCIME—Analcite

Hydrous sodium and aluminum silicate, $NaAlSi_2O_6.H_2O$.

Isometric. Crystals usually trapezohedrons. Also massive granular; compact. Brittle. Vitreous luster. Colorless to white. H. = 5 — 5½. G. = 2.22 — 2.29.

Fuses to a clear glass and shows bright-yellow flame of sodium. Gelatinizes with hydrochloric acid. Gives a small amount of water in a closed tube.

Analcime is a zeolite occurring as a secondary mineral in volcanic rocks and often in large trapezohedral crystals. It is also found as an original constituent in some diabases and basalts.

Alameda County: Analcime occurs as one of the secondary minerals in the cavities of andesitic rock in the Berkeley Hills.

Inyo County: Foshag (24a) reports that boulders of andasitic lava near the Russell Borax mine, and the flows to the south, carry analcime crystals up to 1 cm in diameter in the cavities.

Kern County: Analcime is found with natrolite in cavities in the upper basalt flow at Ricardo in Red Rock Canyon.

Plumas County: It occurs as a hydrothermal mineral in the druses of the pegmatites at Engels, Graton and McLaughlin (17).

Santa Barbara County: It is a constituent of the teschenite of Point Sal and was analyzed by Fairbanks (95), (96).

SiO_2	Al_2O_3	CaO	Na_2O	K_2O	Ign.	
54.40	23.01	0.21	13.33	0.19	8.46 = 99.63%.	G. = 2.261.

Shasta County: It occurs with natrolite in the cavities of basalt 7 miles east of Round Mountain.

Ventura County: Clear crystals of analcime occur with calcite in cavities in basalt at the foot of the southern slope of Mount Pinos.

LAUMONTITE

Hydrous calcium, sodium, and aluminum silicate, $(Ca,Na_2)Al_2Si_4O_{12}.4H_2O$.

Monoclinic. Radiating or divergent columnar. Cleavage perfect basal and clinopinacoidal. Vitreous luster. Color white. Streak uncolored. H. = $3\frac{1}{2}$ — 4. G. = 2.25 — 2.36.

Fuses easily to a glass and shows the reddish flame of calcium. Gelatinizes with hydrochloric acid. Gives water in a closed tube.

Laumontite is a zeolite occurring in cavities of basic volcanic rock, usually with other zeolites.

Plumas County: Laumontite occurs as a hydrothermal zeolite at the Engels mine.

Riverside County: Soft fibrous masses of snow-white laumontite coat some of the green prehnite at the Crestmore quarry. Analysis, Eakle (17).

SiO_2	Al_2O_3	CaO	MgO	H_2O
53.49	22.01	10.80	tr.	13.39 = 99.69%

San Bernardino County: Fibrous white laumontite has been found near the Grant mine, on the right bank of Cucamonga Canyon.

San Diego County: Small amounts of laumontite were found with the axinite crystals of Moosa Canyon near Bonsall, Schaller (11). Laumontite also occurs at Rincon in minute radiating crystals with the forms (110), and ($\bar{2}01$), and as a pseudomorph after stilbite, Rogers (10).

CORDIERITE

Magnesium, iron aluminum silicate, $(Mg,Fe)_2Al_4Si_5O_{18}.H_2O$.

Orthorhombic. Prismatic. Embedded grains, massive. Cleavage (010), distinct. Brittle. Vitreous luster. Color blue. H. = 7 — $7\frac{1}{2}$. G. = 2.60 — 2.66.

Fuses with difficulty. Partially decomposed by acid.

Cordierite occurs chiefly as a constituent of highly aluminous metamorphic rocks.

Tulare County: Cordierite occurs with andalusite, biotite, quartz, and orthoclase in a metamorphic rock on the north side of the South Fork of Kaweah River about two-thirds of a mile southeast of Three Rivers.

PYROPHYLLITE

Hydrous aluminum silicate, $H_2Al_2Si_4O_{12}$.

Orthorhombic. Foliated, radiated lamellar, fibrous; also granular to compact. Cleavage perfect basal. Pearly luster. Color white, apple-green, light-brown, gray. H. = 1 — 2. G. = 2.8 — 2.9.

Fuses usually with exfoliation. Moistened with cobalt nitrate and intensely heated, assumes a blue color. Gives a little water in a closed tube. Partially decomposed by hydrochloric acid. Soft and greasy like talc, but distinguished by the reaction for aluminum.

Imperial County: Pyrophyllite occurs in veins with kyanite and andalusite at the mine of the Vitrefrax Corporation, near Ogilby.

Madera County: Radiating and massive pyrophyllite occurs in schist near the junction of the North Fork of San Joaquin River and Bench Creek, Erwin (34).

Mariposa County: Pyrophyllite occurs in radial aggregates with quartz at Tres Cerritos.

Mono County: Pyrophyllite occurs abundantly in radiating masses and veinlets in andalusite at the mine of Champion Sillimanite, Incorporated, on the western slope of the White Mountains, 7 miles east of Mocalno, Peck (24), Kerr (32).

ANAUXITE

Hydrous aluminum silicate, $Al_2O_3.3SiO_2.2H_2O$.

Monoclinic. In crystal plates with hexagonal outline. Perfect basal cleavage. Luster pearly. Color white or pale-brown. H. = 2½. G. = 2.524.

Amador County: Anauxite was found to be a characteristic constituent of the Ione sandstone on the banks of the Mokelumne River, 1 mile west of Lancha Plana, by Allen (28). Analysis by Fairchild:

SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	Na_2O	K_2O	H_2O	TiO_2
52.46	32.20	1.69	---	0.30	0.25	0.31	13.48	0.55 = 101.24%

Anauxite from the Newman pit near Ione was analyzed by Fairchild, Wells (37).

SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	Na_2O	K_2O	H_2O-	H_2O+	TiO_2
48.80	35.18	1.24	none	0.22	0.25	0.40	1.16	12.81	0.61 = 100.67%

Plumas County: It occurs in minute pale-brown crystals in the cavities of a pyroxene andesite at Drakesbad, Rogers (33).

Tuolumne County: Anauxite was found in minute tabular crystals in the cavities of a pyroxene andesite at Jamestown, Rogers (33).

KAOLINITE

Hydrous aluminum silicate, $Al_2O_3.2SiO_2.2H_2O$.

Monoclinic. Occurs occasionally in scales and plates but is generally massive, earthy, clay-like. Cleavage perfect basal. Flexible. Pearly to dull luster. Color white, yellow, red, brown. H. = 2 — 2½. G. = 2.6.

Pure clays are infusible and insoluble, but some not being pure kaolinite, will fuse to a glass and are slightly soluble. Most will turn a blue color when heated intensely after moistening with cobalt nitrate. Gives water in a closed tube.

Kaolinite forms the base of clays. It is derived by the alteration

of rocks containing aluminum silicates, especially the feldspars, and most good clays come from the alteration of potash feldspar.

Lithomarge is a compact clay consisting partly of kaolinite.

Amador County: Banks of white clay containing silica occur 2 miles north of Carbondale. Fine pure-white kaolinite occurs on the Scully ranch, near Ione.

Calaveras County: Good clay occurs at Valley Springs. Lithomarge occurs near Big Trees.

Lake County: Good quality clay occurs at the Mount Sam mine on Mount Konocti, southeast of Kelseyville.

Los Angeles County: A deposit of kaolinite occurs 6 miles west of Saugus.

Napa County: It was found at the old Redington mine, Knoxville.

Riverside County: Fine kaolinite is found in Hagador Canyon. Soft white clay is present as an alteration of the feldspars at the Crestmore quarry.

Shasta County: Thick, incoherent deposits of kaolinite occur with alunite and opal on the flanks of Brokeoff Mountain, Lassen Volcanic National Park, H. Williams (32).

Sonoma County: A deposit of white kaolin occurs in a hill about a quarter of a mile northeast of Beltane Station, W. W. Bradley (16). Analyses:

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	CaO	MgO	H_2O
Hard	74.60	0.21	15.97	0.50	tr.	0.18	0.06	8.80 = 100.32%
Medium	56.29	0.31	31.13	0.59	---	0.05	0.05	11.67 = 100.09%
Soft	58.10	0.56	26.79	1.17	tr.	0.32	0.05	12.66 = 99.65%

HALLOYSITE

Hydrous aluminum silicate, $Al_2O_3.2SiO_2.nH_2O$.

Massive. Earthy, clay-like. Slightly plastic. Waxy to dull luster. Color white, grayish, greenish, reddish, brown. H. = 1 — 2. G. = 2 — 2.2. Like kaolinite in its blowpipe reactions. Generally classed as a clay.

Imperial County: Halloysite occurs with sulphur, kaolin, and gypsum at a sulphur prospect 6 miles north of 4S ranch and 1½ miles west of the Colorado River, about 35 miles north of Yuma, Kelly (36).

Inyo County: A banded white and brown halloysite occurs at the Cerro Gordo mine, Rogers (12). Halloysite from the Cerro Gordo district was analyzed by Chase Palmer, Wells (37).

SiO_2	Al_2O_3	Ign.
43.11	38.60	17.52 = 99.23%

Mono County: Halloysite from the Detroit Copper mine, near Mono Lake, was analyzed by Clarke, Clarke and Chatard (84).

SiO_2	Al_2O_3	H_2O
42.91	38.13	18.95 = 99.99%

San Diego County: Massive pink halloysite occurs at Pala with gem tourmaline; it has been analyzed by Schaller (04).

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	CaO	MgO	Li_2O	Na_2O	K_2O
43.62	none	35.55	0.21	0.26	1.02	0.19	0.23	0.19	0.03

H_2O at 107°	H_2O ab. 107°
6.63	12.25 = 100.18%

ALLOPHANE

Hydrous aluminum silicate, $Al_2SiO_5.nH_2O$.

Amorphous. Incrustations. Very brittle. Vitreous luster. Pale sky-blue, green, brown, colorless. Streak uncolored. H. = 3. G. = 1.85 — 1.89.

Infusible. Soluble in hydrochloric acid, yielding gelatinous silica. Heated with cobalt nitrate assumes a blue color.

San Bernardino County: Allophane occurs in the veins of the California Rand Silver mine, Hulin (25).

San Luis Obispo County: A specimen has come from Arroyo Grande.

CHLOROPAL

Hydrous iron silicate, $H_4Fe_2Si_2O_9$.

Compact massive, opal-like. Dull luster. Color pistachio-green, greenish-yellow. H. = 2½ — 4½. G. = 1.72 — 2.49.

Infusible. Heated intensely, becomes magnetic. Gives water in a closed tube. Gelatinizes with hydrochloric acid.

Nontronite is a yellowish variety of chloropal.

El Dorado County: Nontronite altered to limonite was observed at Georgetown.

Kern County: Nontronite occurring as veinlets in garnet pyroxene rock near the Woody post office has been analyzed by Steiger, Larsen and Steiger (28), Wells (37).

SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O
47.51	0.37	35.17	None	2.50	1.40	0.06

Na_2O	H_2O at 105°	H_2O ab. 105°	
0.09	7.16	5.90 = 100.16%.	G. = 2.495

Mariposa County: Nontronite has been found with garnet in this county.

Placer County: Specimens of chloropal have come from Bath.

BEIDELLITE

Hydrous aluminum silicate, $Al_2O_3.3SiO_2.4H_2O$.

Orthorhombic? In thin crystal plates. Cleavage (001). Waxy to vitreous luster. Color white, reddish, or brownish-gray. H. = 1½. G. = 2.6.

Infusible. Becomes plastic in water.

Los Angeles County: Beidellite was observed by Beverly (34) at the graphite deposits in the upper part of Elizabeth Lake Canyon, near its junction with the San Andreas Rift Valley, forming patches and filling fractures in orthoclase in a biotite-sillimanite schist.

Sierra County: In the Alleghany district some of the druses in the veins are filled with beidellite, Ferguson and Gannett (32).

MONTMORILLONITE

Hydrous magnesium, calcium, and aluminum silicate, $(Mg,Ca)O.Al_2O_3.5SiO_2.nH_2O$, with $n = 5 - 7$.

Massive, clay-like. Cleavage (001) perfect. Luster feeble. Color white to rose red. Very soft. G. = 2.

The clay known as *bentonite* which has been derived from the alteration of volcanic ash or tuff, is usually composed of montmorillonite.

Inyo County: Montmorillonite is mined under the name of 'amargosite' along the Amargosa River, near Tecopa, Shoshone, and Ash Meadows, Melhase (26). Montmorillonite from Amargosa Valley was analyzed by Fairchild, Wells (37).

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	NA_2O	K_2O	H_2O-	H_2O+	TiO_2
54.58	16.44	2.59	0.11	4.90	0.72	3.02	0.81	11.10	5.49	0.18 = 99.94%

Los Angeles County: Waxy montmorillonite, apparently formed by the alteration of feldspar, occurs in an abandoned quarry in pegmatite 2 miles north of Claremont, Laudermilk and Woodford (34). Analysis by Laudermilk:

SiO_2	Tio_2	Al_2O_3	Fe_2O_3	MnO	CaO	MgO	K_2O	NA_2O	P_2O_5	H_2O
49.70	0.28	22.10	2.12	tr.	1.08	2.85	none	1.17	none	21.14 = 100.44%

San Bernardino County: Large deposits of montmorillonite are reported about 7 miles east of Barstow on the north side of the Mojave River.

San Diego County: Fairchild analyzed: (a) Montmorillonite from this county. (b) Pink montmorillonite from pegmatite from this county, Wells (37).

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	NA_2O	K_2O	H_2O-	H_2O+	TiO_2	MnO	Cl
(a)__	53.96	15.44	1.12	tr.	6.99	0.80	0.94	0.54	14.22	6.34	0.19	___	0.29 = 100.83%
(b)__	50.06	21.32	0.22	tr.	4.42	1.26	0.33	0.19	14.06	7.56	tr.	0.13	___ = 99.55%

Under the local name of '*Otaylite*' commercial shipments of montmorillonite have been made from a deposit 3 miles southeast of Otay.

Ventura County: Montmorillonite is the essential constituent of the bentonite clay beds on the west bank of the Ventura River 2 miles south of the Ventura Avenue oil field, along Los Sauces Creek 2 miles north of the Rincon oil field, at the mouth of Rincon Creek and near Oakview, Kerr (31).

TALC

Hydrous magnesium silicate, $H_2Mg_3Si_4O_{12}$.

Monoclinic. Foliated massive to granular and compact massive. Cleavage basal, perfect. Sectile. Pearly luster. Color white, pale-green, apple-green, gray, brown. Streak white. Feel greasy. H. = 1 — 1½. G. = 2.7 — 2.8.

Infusible. Insoluble in acid. Gives water in closed tube on intense ignition.

Talc is common in the metamorphic rocks of the State, forming talc schists. It occurs as a hydration product in the alteration of magnesian silicates, and is often associated with serpentine and with actinolite.

Soapstone is a coarse granular, grayish-green to brownish-gray variety.

Alameda County: Light-green talc outcrops in the serpentine about 20 miles southeast of Livermore.

Amador County: Talc occurs in the schists near Jackson. Excellent foliated talc occurs at Plymouth. Light-green talc occurs on the Tonzi ranch, 6 miles northeast of Ione.

Butte County: Soapstone occurs near Flea Valley and Clear Creek. Narrow seams of talc occur in the Big Bend of the North Fork of Feather River. Gray soapstone occurs near Buck's ranch. Massive soapstone was found near Poe Station, 30 miles east of Oroville; also at McLean's Spur. Talc has come from near Swayne.

Calaveras County: Talc seams are found 2 miles northeast of Angels Camp and on Quail Hill. Deposits of talc occur 2½ miles west of Murphys and 1½ miles south of Vallecito. Massive soapstone occurs 4 miles east of Valley Springs. A large deposit of talc was found 6 miles east of Mokelumne Hill, on the Calaveras River.

Contra Costa County: An analysis of the talc from the schists near San Pablo was made by Blasdale (01).

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	H_2O at 100°	H_2O ab. 100°
56.02	9.02	1.10	5.14	24.10	0.60	0.16	4.34 = 100.48%

El Dorado County: Talc occurs in the Kelsey district and at Georgetown. Good talc or soapstone occurs near Shingle Springs and near Latrobe.

Fresno County: Talc occurs in schist in Watts Valley and in the Kings River Canyon.

Glenn County: Talc seams occur with the serpentine on the western border of the county. Specimens of talc have come from near Willows.

Imperial County: Talc occurs with kyanite and dumortierite at the mine of the Vitrefrax Corporation, about 4 miles northeast of Ogilby, Melhase (25), (34).

Inyo County: Fine greenish and white talc occurs near Keeler. Pure white talc is found at contact of limestone and diorite, 8 miles southwest of Zabriskie. White and gray indurated talc occurs in the Darwin district. A deposit of soft silvery talc occurs at Acme Siding. A fine bluish-white talc, which can be cut into blocks, occurs near Keeler. High-grade talc occurring in lenticular masses and veins in dolomite has been mined about 8 miles west of Darwin on the Darwin-Olancha road, W. W. Bradley (35).

Kern County: Talc occurs on Soapstone Mountain and near Goler and Randsburg. Foliated masses of talc are found near Kernville.

Los Angeles County: Soapstone is found with serpentine at Empire Landing, Santa Catalina Island. Talc occurs close to the Red Rover mine, near Acton. Talc occurs in veins and lenses in many places in the schists of the Sierra Pelona and a large number of claims have been located on talc in Bouquet Canyon, Simpson (34).

Madera County: Talc schist from which large blocks of soapstone can be obtained occurs on the north side of the San Joaquin River, above Friant.

Marin County: Talc is found near San Rafael and Taylorville.

Mariposa County: Small amounts of talc are found near Princeton, and in the Lewis district. Gray soapstone occurs near Coulterville.

Napa County: Seams of talc with serpentine are found in the Chiles district. Massive green talc is found on the Fir Hill ranch, 2 miles west of Chiles.

Nevada County: It occurs in the Grass Valley region.

Placer County: Outcrops of talc occur a few miles north of Colfax. Small amounts of talc have been found near Clipper Gap. Soapstone occurs at the Bobtail mine in the Rock Creek district.

Riverside County: White, scaly talc occurs about 3 miles southwest of Winchester, and near Perris.

Sacramento County: Talc occurs with chromite on Bear Mountain, near Mormon Island.

San Benito County: Talc is found between San Benito and Clear Creeks.

San Bernardino County: A talcose clay called rock soap is found near Waterman. A large deposit of white crystalline talc near Silver Lake is mined by the Pacific Coast Talc Company, Wicks (30). White talc from Riggs has been analyzed by Wells (37).

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	H_2O
60.88	0.36	0.10	0.33	28.85	4.28	4.50 = 99.30%
63.36	0.46	0.09	0.30	27.60	3.49	3.92 = 99.22%

San Diego County: Soapstone is found near National City, at Otay, and in the Tia Juana Valley. Talc has been found about 5 miles from Escondido.

Santa Barbara County: Soapstone occurs on the Santa Maria River.

Santa Cruz County: Talc occurs near Aptos.

Shasta County: Talc is found on Boulder Creek. Commercial shipments of talc have been made from the Ganim gold mine, 2½ miles northwest of Schilling.

Sierra County: Soapstone suitable for slabs has been quarried near Pike City.

Siskiyou County: Talc occurs in several localities associated with the serpentine in this county. It is found near Etna, near Fort Jones, near the head of Wolley Creek, near Scott, and in the Cottonwood Mountains on the divide between Beaver and Bumble Bee Creeks. A large mass of soapstone occurs a few miles southeast of Hamburg Bar.

Sonoma County: A soft green talc is found with actinolite at Petaluma.

Tehama County: Soapstone mixed with limonite has come from Paskenta.

Trinity County: Light-gray soapstone occurs on Browns Mountain.

Tulare County: Talc occurring in small seams with calcite near Porterville has been analyzed by Foshag and Wherry (22).

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	H_2O+	H_2O-
57.44	none	none	1.85	31.74	1.14	7.76	.28 = 100.21%

Tuolumne County: Talc occurs at Shaws Flat and on Yankee Hill. A deposit of talc occurs near Shawmut.

Yuba County: Soapstone has been quarried for local use below Weeds Point, near Camptonville, and near Challenge and Oak Valley.

SEPIOLITE—Meerschaum

Hydrous magnesium silicate, $H_4Mg_2Si_3O_{10}$.

Orthorhombic. Fibrous, compact. Earthy texture and smooth feel. Dull luster. Color white. H. = 2 — 2½. G. = 2. When dry floats on water.

Difficult to fuse. Heated in closed tube, gives off water. Moistened with cobalt nitrate and intensely heated, assumes a pink color. Soluble in hydrochloric acid without forming a jelly.

Inyo County: Sepiolite was mentioned by Hanks (84) as possibly occurring at the Half Dollar mine.

Mariposa County: An excellent quality of sepiolite was found on a copper claim just east of Mariposa.

Riverside County: Sepiolite occurs in small veins in calcite at Crestmore, Daly (35).

GARNIERITE

Hydrous magnesium and nickel silicate, $H_2(Ni,Mg)SiO_4+H_2O$.

Amorphous. Clay-like masses with pod-shaped concretions. Dull luster. Color apple-green to nearly white. Soft and friable. G.= 2.3—2.8

Infusible. Gives with borax a violet bead while hot and a brown bead when cold. Soluble in hydrochloric acid with separation of silica. Gives water in a closed tube.

Imperial County: Garnierite was reported to occur on the southern slope of the Coyote Mountains.

DEWEYLITE

Hydrous magnesium silicate, $4MgO.3SiO_2.6H_2O$.

Amorphous. Massive, gum-like. Greasy luster. Color whitish, yellowish, reddish. H. = 2 — 3½. G. = 2 — 2.2

Like serpentine in its reactions.

Napa County: Deweylite occurs as a gangue mineral with the gold and silver ores of the Palisades mine, 2 miles north of Calistoga.

Riverside County: Daly (35) has described the occurrence of deweylite with chrysotile in the Chino quarry at Crestmore.

Santa Clara County: Crusts of deweylite have been found at the Western magnesite mine on Red Mountain, Rogers (12).

NEOTOCITE

Hydrous manganese and iron silicate, $MnO.SiO_2nH_2O$.

Amorphous. Dull luster. Color black to dark-brown. H. =3 — 4. G. = about 2.8

Gives green bead of manganese when fused with sodium carbonate. Soluble in acid. Yields water in a closed tube.

Neotocite is common in the manganese deposits of the State.

Humboldt County: Neotocite was abundant in resinous-brown to almost black masses at the Woods mine, 12 miles northwest of Blocksburg.

Lake County: It occurred with psilomelane at the Witter Springs mine.

Mendocino County: Neotocite was abundant in light and dark-brown masses in the Thomas mine. It was found in the manganese deposits of Mount Sanhedrin.

Sonoma County: It occurred in chert with psilomelane at the Aho mine, 6 miles west of Cazadero.

CELADONITE

Hydrous iron, magnesium, and potassium silicate.

Earthy or in minute scales. Color deep olive-green or apple-green. Greasy feel. H. = 1. G. = 2.7

Fusible. Soluble in hydrochloric acid.

San Mateo County: A specimen has come from near San Mateo.

CUSTERITE

$[Ca(F,OH)]_2SiO_3$.

Monoclinic. Fine granular masses. Basal and prismatic cleavage. Color greenish-gray. H. = 5. G. = 2.91.

Difficultly fusible. Dissolves with separation of gelatinous silica.

Riverside County: Custerite with idocrase was found by Tilley (28) in a metamorphic rock from Crestmore.

CENTRALLASITE

Hydrous calcium silicate, $4CaO.7SiO_2.5H_2O$.

Platy or lamellar to compact. Color white. H. = 2½. G. = 2.51.

Fuses easily with intumescence. Soluble in hydrochloric acid with separation of silica.

Riverside County: Centrallasite was described by Foshag (24c) as occurring with feldspar in a pegmatite in the Wet Weather quarry at Crestmore. Analysis by Foshag:

H_2O	SiO_2	Al_2O_3	CaO	MgO
11.88	57.00	0.26	30.86	0.20 = 100.20 %

GYROLITE

Hydrous calcium silicate, $H_2Ca_2Si_3O_9.H_2O$.

Hexagonal-rhombohedral. Fibrous and lamellar concretions. Perfect basal cleavage. Vitreous luster. Colorless and white. H. = 3 — 4. G. = 2.34 — 2.45.

Fuses easily to a blebby glass and gives the yellowish-red flame of calcium. Soluble in acid with some gelatinization. Gives water in a closed tube.

Gyrolite is formed as a secondary mineral in crevices of rocks by the alteration of lime silicates.

San Francisco County: Gyrolite occurs lining fissures in the rock at Fort Point; it was analyzed by Schaller (05a).

SiO_2	Al_2O_3	CaO	Na_2O	Ign.	
53.47	0.22	32.00	1.25	13.21 = 100.15%	G. = 2.39

Santa Clara County: Fibrous gyrolite with apophyllite and bituminous matter occurred in the crevices of the cinnabar mine at New Almaden; it was analyzed by Clarke (89).

SiO_2	$Al_2O_3Fe_2O_3$	CaO	Na_2O	K_2O	F	Ign.	F—O
52.54	.71	29.97	.27	1.56	.65	14.60 = 100.30	—.27 = 100.03%

BEMENTITE

Hydrous manganese silicate $H_{10}Mn_8Si_7O_{27}$.

Orthorhombic. Fine fibrous masses and granular. Luster vitreous to pearly. Color pale grayish-yellow to light-brown. H. = 3. G. = 2.98.

Fuses easily to a dark-brown glass. Soluble in hydrochloric acid without gelatinization. Gives green bead of manganese with sodium carbonate.

Bementite appears to be abundant in some of the psilomelane deposits of the State. It is characteristically associated with rose-red inesite and brown neotocite.

Alameda County: Bementite occurs in the Arroyo Mocho manganese ore. It was observed at the Bailey mine with inesite and gray rhodochrosite.

Humboldt County: It occurred with brown neotocite and rhodochrosite at the Woods mine, 12 miles northwest of Blocksburg.

Mendocino County: Granular pale-brown bementite occurs with neotocite and psilomelane at the Thomas mine, 6 miles northeast of Redwood. It was found with inesite and neotocite at the Mount Sanhedrin deposits, especially in the Rhodochrosite claim at Impassable Rock.

San Joaquin County: Bementite occurs in masses at the old Ladd manganese mine.

Stanislaus County: It is a constituent of the ore from the Cummings lease on the Winship property, where it occurs granular, mixed with gray rhodochrosite and rose-red inesite.

APOPHYLLITE

Hydrous calcium and potassium fluosilicate, $KF.Ca_4(Si_2O_5)_4.8H_2O$.

Tetragonal. Square prisms, pyramids, massive. Cleavage perfect basal. Brittle. Pearly to vitreous luster. Colorless, white, grayish, pale-violet, greenish, yellowish. H. = $4\frac{1}{2}$ — 5. G. = 2.3 — 2.4.

Fuses with swelling to white enamel and shows the violet flame of potassium. Gives much water in a closed tube. Soluble in hydrochloric acid, but without gelatinization.

Apophyllite is a secondary mineral found in cavities of volcanic rock.

Plumas County: Crystals of apophyllite occur in cavities of basalt at the Buckeye mine, near Onion Valley.

Marin County: Short prismatic glassy crystals of apophyllite occur with calcite and wollastonite in cracks in quartzite on the west shore of Tomales Bay, $1\frac{1}{2}$ miles northwest of Inverness.

Riverside County: Cavities in the massive wollastonite at Crestmore are lined with small crystals of colorless and white apophyllite. The forms identified are: (100), (111), and (001), Eakle (17).

San Francisco County: A few crystals of apophyllite were found at Fort Point with the forms (001), (111), and (100), but most of them were changed into quartz pseudomorphs, Schaller (04).

Santa Clara County: Apophyllite was found at New Almaden in large crystals with gyrolite and bituminous matter, Clarke (89).

OKENITE

Hydrous calcium silicate, $H_2CaSi_2O_6.H_2O$.

Triclinic. Finely fibrous and acicular. Cleavage (010) perfect. Pearly luster. Color snow-white. H. = 4½ — 5. G. = 2.2 — 2.3.

Fuses to a glass and colors flame reddish. Soluble in hydrochloric acid with slight gelatinization. Gives water in a closed tube.

Riverside County: Okenite occurs as an alteration product of wilkeite in the limestone at Crestmore, Eakle and Rogers (14). Radiating botryoidal coatings of okenite occur on apophyllite as an alteration product. It also occurs associated with idocrase and xanthophyllite. Forms ($1\bar{1}0$), (110), ($0\bar{1}1$), (010), (011), and analysis were reported by Foshag, Eakle (17). Analysis:

SiO_2	CaO	H_2O	
56.17	26.10	16.83 = 99.10%.	G. = 2.206.

GILLESPITE

Iron and barium silicate, $FeO.BaO.4SiO_2$.

Tetragonal. Basal cleavage. Color red. H. = 4. G. = 3.33.
Fuses very easily. Decomposed by hydrochloric acid.

Mariposa County: Gillespite has been found with sanbornite and celsian in a vein in quartzite, about 1 mile north of Trumbull Peak, near Incline, Rogers (32a).

SANBORNITE

Barium silicate, $BaSi_2O_5$.

Triclinic. Platy. Micaceous cleavage. Vitreous luster. Colorless to white. H. = 5. G. = 4.19.

Decomposed by hydrochloric acid, with swelling of plates.

Mariposa County: Sanbornite was first found in California with celsian and gillespite in a metamorphic rock 1 mile north of Trumbull Peak, near Incline. It was described and named by Rogers (32a) with analysis by O. C. Shepard:

SiO_2	Al_2O_3	Fe_2O_3	CaO	SrO	BaO
42.2	1.5	tr.	0.1	0.2	50.4 = 94.4%

CHLORITES

The chlorites are a group of soft micaceous alumino-silicates of iron and magnesium. The species below grade into one another by continuous variations in composition. The chlorites are common con-

stituents of metamorphic rocks and as such are usually referred to by group name.

PENNINITE

Hydrous magnesium, iron, and aluminum silicate, $H_8(Mg,Fe)_6Si_4O_{18}$ to $H_8(Mg,Fe)_5Al_2Si_3O_{18}$.

Monoclinic. Plates, scales, scaly massive. Cleavage perfect basal. Pearly to vitreous luster. Color emerald-green, grass-green, violet, rose-red. H. = 2 — 2½. G. = 2.6 — 2.85.

Fusibility 5 — 5½. Completely decomposed by sulphuric acid.

Penninite is similar to clinochlore but has more iron in its composition.

Kämmererite is a peach-blossom red variety associated with chromite.

Alameda County: Reddish-violet kämmererite occurs with chromite on Cedar Mountain at the Mendenhall mine, Rogers (12).

Del Norte County: Kämmererite has been observed coating chromite from this county.

Placer County: Kämmererite occurs in chromite in Green Valley, above Dutch Flat. Shannon (20a) has analyzed a chromiferous chlorite from the mine of the Placer Chrome Company, 6 miles south of Newcastle.

SiO_2	Al_2O_3	Cr_2O_3	FeO	MgO	CaO	H_2O
29.36	18.81	1.53	1.65	35.67	2.20	11.34 = 100.56%

San Benito County: Red kämmererite occurs on chromite associated with uvarovite at New Idria, Brush (66).

Shasta County: Kämmererite coats chromite in the Little Castle Creek mine, near Dunsmuir.

Siskiyou County: Kämmererite occurs with chromite and uvarovite at the Martin McKean mine, near Callahan, Melhase (35a).

Yuba County: Kämmererite is found with uvarovite and chromite at the Red Lodge mine, Melhase (35a).

CLINOCHLORE

Hydrous magnesium and aluminum silicate, $H_8Mg_5Al_2Si_3O_{18}$.

Monoclinic. Scaly, earthy, compact. Cleavage perfect basal. Pearly luster. Deep grass-green, olive-green, rose-red. Streak greenish-white to uncolored. Plates are flexible, but without elasticity, thus differing from the micas. H. = 2 — 2½. G. = 2.65 — 2.78.

Practically infusible. Decomposed by boiling sulphuric acid. Gives water in a closed tube when intensely heated.

Clinochlore occurs as an alteration product of magnesian-iron minerals and is common in schists.

Kotschubeite is a rose-red variety of clinochlore containing chromium, and is associated with chromite in serpentine rocks.

Calaveras County: Pink chrome chlorite has been found near Angels Camp.

Nevada County: Fine chrome chlorite, pink and green, occurs on chromite at the Red Ledge mine, Washington district.

Placer County: Rose-red kotschubeite occurs on chromite in the serpentine of Green Valley, above Dutch Flat, Lindgren (88). It was analyzed by Melville.

SiO_2	Al_2O_3	Cr_2O_3	FeO	NiO	CaO	MgO	H_2O at 105°	H_2O ab. 105°		
31.74	6.74	11.39	1.23	0.49	0.18	35.18	0.37	12.68	=100.00%.	G. = 2.69

Riverside County: Clinochlore occurs in pale-green flakes with idocrase in the limestone at Crestmore, Eakle (17).

Siskiyou County: A chrome chlorite occurs near Dunsmuir.

PROCHLORITE

Hydrous magnesium, iron, and aluminum silicate, $H_8(Mg,Fe)_5Al_2Si_3O_{18}$ to $H_8(Mg,Fe)_4Al_4Si_2O_{18}$.

Monoclinic. Scaly, foliated, granular, massive. Cleavage perfect basal. Pearly luster. Color green, blackish-green, brown. Streak uncolored or greenish. H. = 1 — 2. G. = 2.78 — 2.96.

Like clinochlore in its reactions. Iron-rich varieties become magnetic after heating.

Prochlorite forms large flaky masses in schists.

Butte County: Prochlorite is a constituent of the schists at Forbestown, specimens coming from the Gold Bank mine.

Contra Costa County: Prochlorite was described and analyzed from the schists near San Pablo by Blasdale (01).

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	H_2O at 100°	H_2O ab. 100°		
27.38	26.15	0.78	12.70	18.92	---	1.15	1.51	11.44	=100.03%.	G. = 2.792

JEFFERISITE

Hydrous magnesium, iron, and aluminum silicate, $10(Mg,Fe)O.4(Al,Fe)_2O_3.10SiO_2.7H_2O$.

Broad plates, small scales. Cleavage perfect basal. Pearly luster. Color dark yellowish-brown. H. = 1½. G. = 2.30.

Rather difficult to fuse, but exfoliates when heated. Soluble in hydrochloric acid, but without gelatinization. Gives water in a closed tube.

Jefferisite is a hydrated mica.

Lassen County: Large brown plates of jefferisite occur at Susanville according to Hanks (84).

Tulare County: Hanks (84) mentions jefferisite from this county.

IDDINGSITE

Hydrous magnesium and iron silicate, $MgO.Fe_2O_3.3SiO_2.4H_2O$.

Othorhombic. Lamellar crystals. Cleavage perfect macropinacoidal. Bronze luster. Color chestnut-brown to yellowish-green. H. = $2\frac{1}{2}$ — 3. G. = 2.84.

Infusible. Becomes magnetic when heated. Decomposed by hydrochloric acid.

Inyo County: Iddingsite occurs abundantly in a basalt flow about one kilometer southeast of the Russell Borax mine, Foshag (24a).

Monterey County: Iddingsite is a prominent constituent of the basic extrusive rock, carmeloite, found about Carmelo Bay. It was recognized as a new mineral and named by Lawson (93).

SAPONITE

Hydrous magnesium and aluminum silicate, $9MgO.Al_2O3.10SiO_2.15\text{-}16H_2O$.

Monoclinic or orthorhombic. In minute scales. Commonly massive. In nodules, or filling cavities. Greasy luster. Color white, yellowish, grayish-green, reddish. Soft. G. = 2.24 — 2.30.

Fuses with difficulty. Yields water readily in a closed tube. Decomposed by sulphuric acid.

San Bernardino County: The bentonitic magnesian clay mineral described by Foshag and Woodford (36) from a quarry $3\frac{1}{2}$ miles south of Hector, in Death Valley, is probably to be classed as saponite. Analysis by Foshag:

SiO_2	Al_2O_3	CaO	MgO	Na_2O	K_2O	Li_2O	H_2O+	H_2O-	Cl
53.68	0.60	0.52	25.34	3.00	0.07	1.12	8.24	7.28	0.31 = 100.16%

Saponite from Hector has also been analyzed (a) by Fairchild and (b) by Stevens, Wells (37).

	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	Na_2O	K_2O
(a)	57.50	0.68	0.24	25.98	0.47	2.48	0.45
(b)	51.26	0.36	0.09	23.25	2.60	3.47	0.10

	Li_2O	H_2O-	H_2O+	CO_2	TiO_2	P_2O_5	SrO
(a)	---	3.52	6.88	---	0.02	0.34	--- = 98.56%
(b)	0.60	11.56	5.14	1.35	---	---	tr. = 99.78%

GRIFFITHITE

Hydrous magnesium, iron, calcium, and aluminum silicate, $4(Mg,Fe,Ca)O.(Al,Fe)_2O_3.5SiO_2.7H_2O$.

Monoclinic Basal plates and shreds. Cleavage basal. Sectile. Color dark-green. H. = 1. G. = 2.309.

Fuses with intumescense to a black magnetic slag. Soluble in hydrochloric acid with gelatinization.

Los Angeles County: A chlorite filling amygdaloidal cavities in basalt at Cahuenga Pass, Griffith Park, Los Angeles, was named griffithite by Larsen and Steiger (17). Analysis by Steiger:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O
39.64	9.05	7.32	7.83	15.30	2.93	0.71

K_2O	H_2O-	H_2O+	TiO_2
none	12.31	4.90	none = 100.49%

STILPNOMELANE

Hydrous iron, magnesium, and aluminum silicate, $2(Fe,Mg)O.(Fe,Al)_2O_3 5SiO_2 3H_2O$.

Monoclinic. In minute scales. Flexible. Brassy to submetallic luster. Color black, yellowish and greenish-bronze. H. = 3 — 4. G. = 2.77 — 2.96.

Fuses with difficulty and becomes magnetic. Decomposed by hydrochloric acid, but without forming a jelly. Gives much water in a closed tube.

Chalcodite is a rare brown variety, occurring in minute scales, often with a bronze luster.

Inyo County: Stilpnomelane occurs as bronze-brown flakes on analcite and natrolite in the amygdules of an andesite on the Furnace Creek wash, 2 miles west of Ryan.

Santa Barbara County: Brown crystals of chalcodite have come from this county.

BRITTLE MICAS

The brittle micas are similar to the micas in form and structure but are harder and more brittle. They do not contain potassium, which is an important constituent of micas, whereas they may contain calcium which is absent in micas. They are characteristic of the crystalline schists and gneisses.

MARGARITE

Hydrous calcium and aluminum silicate, $H_2CaAl_4Si_2O_{12}$.

Monoclinic. Usually in aggregated laminae, sometimes massive; scaly. Cleavage perfect basal. Brittle. Pearly luster. Color grayish-pink. H. = 3½ — 4½. G. = 2.99 — 3.08.

Fuses with difficulty. Yields water in the closed tube. Slowly decomposed by hydrochloric acid.

Margarite is prominent in the glaucophane rocks and has been observed in several localities.

Marin County: Margarite was mentioned by Ransome (95) as an associate of the lawsonite at Reed Station. Much of this, however, is muscovite, Eakle (06).

San Mateo County: It is a constituent of the schists of Belmont, Murgoci (06).

Santa Clara County: It occurs in the eclogite of Oak Ridge, J. P. Smith (06).

Sonoma County: It is a constituent of the glaucophane gneiss of Melitta, near Santa Rosa, Murgoci (06).

XANTHOPHYLLITE

Hydrous magnesium, calcium, and aluminum silicate, $H_8(Mg,Ca)_{14}Al_{16}Si_5O_{52}$.

Monoclinic. Tabular crystals parallel to the base. Perfect basal cleavage. Plates are not flexible. Vitreous luster. Color leek-green or bottle-green. H. = 4 — 5. G. = 3.08.

Infusible and insoluble. Gives water when intensely heated in a closed tube.

Riverside County: Abundant platy crystals of xanthophyllite

occurred in the blue calcite of the cement quarry at Crestmore, intimately associated with monticellite. Analysis by Eakle (16) gave:

SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	H_2O	
16.74	42.70	2.85	0.41	13.09	20.03	4.49 = 100.31%	G. = 3.081

CHLORITOID

Hydrous iron, magnesium, manganese, and aluminum silicate, $H_2(Fe,Mg,Mn)Al_2SiO_7$.

Monoclinic or triclinic. Foliated massive, scales. Cleavage perfect basal. Plates flexible, but not elastic. Pearly to vitreous luster. Color dark-gray, grayish-black, grass-green. Streak uncolored or grayish. H. = 6½. G. = 3.52 — 3.57.

Infusible and insoluble. Gives much water in a closed tube.

Ottrelite is used as a synonym for chloritoid, and as a name for varieties rich in manganese.

Calaveras County: Dark-green chloritoid has been found in some of the schists of this county.

Inyo County: It occurs in dark-green oblong plates in schists on the west side of the Panamint Range, 5 to 10 miles east of Ballarat, Murphy (32).

Siskiyou County: A specimen of ottrelite schist has come from near Yreka.

PREHNITE

Calcium and aluminum silicate, $H_2Ca_2Al_2Si_3O_{12}$.

Orthorhombic. Tabular crystals, granular, drusy masses. Cleavage (001) distinct. Vitreous luster. Color light green to white, brown. Streak uncolored. H. = 6 — 6½. G. = 2.8 — 2.95.

Fuses with intumescence to an enamel. Gives water in a closed tube. The fused mass will gelatinize with hydrochloric acid. Slightly soluble.

Green drusy coatings and veins of prehnite are sometimes present in altered diabase and lavas, but it is not common in the State.

Colusa County: Prehnite has been found in veins with calcite and pectolite in serpentine near Wilbur Springs.

Plumas County: It occurs as a hydrothermal product at the Engels mine.

Riverside County: Green drusy and light-brown prehnite occur in cavities of white feldspar in the pegmatite veins of the limestone at Crestmore, Eakle (17). Forms of brown crystals are: (001), (110), (100), and (061). Analysis of the brown prehnite:

SiO_2	Al_2O_3	CaO	H_2O
44.10	24.20	25.20	5.86 = 99.36%

San Diego County: Prehnite from Smiths Mountain, near Oak Grove, has been analyzed by Schaller, Clarke (15).

	SiO_2	Al_2O_3	Fe_2O_3	CaO	H_2O	F	
1.	43.48	24.52	0.34	27.19	4.32	0.17 = 100.02%	G = 2.895 — 2.909.
2.	42.63	26.64		27.05	4.26	= 100.58%	

Santa Barbara County: Prehnite occurs in the analcite-diabase of Cuyamas Valley, Fairbanks (95).

MICAS

The micas are a group of silicates having a characteristic crystal structure and occurring chiefly in thin elastic scales or plates with a perfect cleavage.

MUSCOVITE—Potash Mica

Hydrous potassium and aluminum silicate, $(OH)_2KAl_2(AlSi_3O_{10})$.

Monoclinic. Hexagonal-shaped plates, plumose aggregates, scales, compact massive. Cleavage perfect basal. Vitreous luster. Colorless, gray, brown, pale-green, yellow, pink. Streak uncolored. H. = 2 — 2½. G. = 2.76 — 3.

Very difficult to fuse. A little of the powder taken on a platinum wire and moistened with sulphuric acid will give the violet flame of potassium when held in the colorless Bunsen flame. A small amount of moisture is obtained by intense heating in a closed tube. Insoluble in acids.

Muscovite is a common constituent of granites, pegmatites, gneisses, and schists. It is generally called mica or isinglass, and is of economic value when in large transparent sheets. Extensive areas of mica-schists occur in the State, in which muscovite is a principal constituent and gives the rock its schistose structure.

Sericite is a soft greasy-feeling muscovite forming sericitic schists.

Fuchsite is an emerald-green chrome-muscovite.

Agalmatolite is a grayish compact or altered muscovite.

Calaveras County: Fine grained micaceous material, apparently muscovite, coating quartz from Melones was analyzed by Fahey, Wells (37).

SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	Na_2O	K_2O	H_2O-	H_2O+	TiO_2
50.60	31.07	3.00	0.72	none	none	6.43	0.13	7.47	0.83 = 100.25%

Sericite enclosing euhedral quartz crystals occurred in the Utica mine at Angels Camp.

El Dorado County: According to Hanks (84) some material resembling agalmatolite occurred in a vein at Greenwood.

Imperial County: Sericite is commercially produced at Ogilby.

Inyo County: Muscovite is found in the Saratoga district.

Lassen County: Muscovite was early reported from Susanville.

Mariposa County: Sericite is being produced at Three Buttes in T. 6 S., R. 16 E., M. D. M.

Nevada County: Sericite and biotite are mentioned by Lindgren (96) as constituents of the rocks of Grass Valley and Nevada City.

Orange County: Fuchsite has been found at Arch Beach.

Plumas County: Sericite occurs at Engels.

Riverside County: Muscovite and lepidolite occur with the gem tourmaline at Coahuila.

San Bernardino County: Fuchsite occurs in schist in Cascade Canyon, a tributary of San Antonio Canyon.

San Diego County: Muscovite is a common mineral in the pegmatite veins which carry the gem tourmaline and kunzite of this county. Crystals of muscovite occur at the Mack mine, Rincon, with the forms: (001), (010), and (221), Rogers (10). Pink muscovite from Mesa Grande has been analyzed by Schaller, Clarke (15).

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO
45.63	tr.	37.42	tr.	0.06	none	none

Li_2O	Na_2O	K_2O	H_2O	F		O=F	
0.20	1.43	9.95	4.43	0.77	= 99.89	— 0.32	= 99.57%

Rogers (10a) has described a pseudomorph of muscovite after tourmaline from Pala.

Ventura County: Good sheets of muscovite have come from the Mount Almo mica mine.

MARIPOSITE

Monoclinic. In hexagonal plates and scales, foliated, micaceous. Cleavage perfect basal. Vitreous luster. Color apple-green, white. H. = $2\frac{1}{2}$ — 3. G. = 2.78 — 2.81.

Similar to muscovite in its reactions. An emerald-green borax bead is sometimes obtained.

Mariposite is essentially a muscovite with a characteristic green color due to the presence of chromic oxide. It is distinctly characteristic of the gold belt of the Sierra Nevada, and was described as a new mineral by Silliman (68). It is considered by some mineralogists to be identical with alurgite.

Calaveras County: Mariposite occurs in schist at the Reserve and Golden Gate mines on Carson Hill.

El Dorado County: Green flakes of mariposite occur in quartz at the Pyramid mine, 4 miles north of Shingle Springs.

Kern County: Green micaceous mariposite occurs at Randsburg, Hulin (25).

Mariposa County: The green mica, mariposite, is common in the Mother Lode schists of this county and of Tuolumne and Calaveras counties. Mariposite from the Josephine mine was analyzed by Hillebrand, Turner (96).

<table>
<tr><th></th><th>SiO_2</th><th>TiO_2</th><th>Al_2O_3</th><th>Cr_2O_3</th><th>Fe_2O_3</th><th>FeO</th><th>CaO</th><th>MgO</th></tr>
<tr><td>Green</td><td>55.35</td><td>0.18</td><td>25.62</td><td>0.18</td><td>0.63</td><td>0.92</td><td>0.07</td><td>3.25</td></tr>
<tr><td>White</td><td>56.79</td><td colspan="2">25.29</td><td>none</td><td colspan="2">1.59</td><td>0.07</td><td>3.29</td></tr>
</table>

	K_2O	$(Li,Na)_2O$	H_2O		
Green	9.29	0.12	4.52	= 100.13%	G. = 2.817.
White	8.92	0.17	4.72	= 100.84%	G. = 2.787.

Nevada County: Green mariposite occurs with quartz and calcite in veins at the Red Ledge mine, Washington. It also occurs at the Idaho mine, Grass Valley.

Placer County: It was found at the Marguerite mine.

San Diego County: It was found near Oak Grove and on the west side of San Jacinto Mountain.

Sierra County: Mariposite was found at the Rainbow mine. It occurred at the Alhambra mine, Poker Flat, and at the El Dorado mine, in the Forest mining district.

Tuolumne County: Mariposite was common at the Rawhide ranch mine, near Tuttletown. It was found at the App, Omega, and other mines, near Jamestown.

ROSCOELITE—Vanadium Mica

Hydrous potassium, aluminum, and vanadium silicate, $H_2K(Al,V)_3(SiO_4)_3$.

Monoclinic. In minute scales, often in stellate groups. Cleavage perfect basal. Pearly luster. Color clove-brown to greenish-brown, and dark green. H. = 2½. G. = 2.97.

Similar to biotite in its reactions, but in addition gives a green bead of vanadium with phosphorous salt.

Vanadium is a rare constituent of some igneous rocks, and is occasionally found in small amounts in biotite. Roscoelite is unique in having a large percentage of vanadium in place of iron, thus forming a vanadium-mica.

El Dorado County: Layers of a dark-green micaceous mineral, up to half an inch in thickness, interlaminated with gold, found at the Stuckslager or Sam Sim's mine on Granite Creek, near Coloma, proved to be a new mineral and was named roscoelite by J. Blake (75). It was later described and analyzed by Genth (76), Roscoe (76), and Hillebrand, Turner and Clarke (99).

	SiO_2	TiO_2	V_2O_3	V_2O_5	V_6O_{11}	Al_2O_3	Fe_2O_3
Genth	47.69	---	----	----	22.02	14.10	---
Roscoe	41.25	---	----	28.60	----	14.14	1.13
Hillebrand	45.17	0.78	24.01	----	----	11.54	---

Mn_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Li_2O	H_2O
----	1.67	2.00	tr.	0.19	7.59	tr.	4.96 = 100.22%
							G. = 2.938
1.15	---	2.01	0.61	0.82	8.56	---	3.35 = 101.62%
----	1.60	1.64	---	0.06	10.37	tr.	4.69 = 99.86%

Several hundred pounds of roscoelite were found in Big Red Ravine, near the old Sutter Mill, in Sec. 31, T. 11 N., R. 10 E., M. D. M., but were destroyed to obtain the interlaminated gold, Hanks (81).

BIOTITE

Hydrous potassium, magnesium, iron, and aluminum silicate, $(OH)_2K(Mg,Fe)_3(AlSi_3O_{10})$.

Monoclinic. Tabular or short prismatic. In hexagonal plates. Foliated, scaly, micaceous. Cleavage perfect basal. Vitreous to pearly luster. Black, dark-brown, green. Streak uncolored. H. = $2\frac{1}{2}$ — 3. G. = 2.7 — 3.1.

Very difficult to fuse. Iron-rich varieties become magnetic on heating. Gives a little water in a closed tube. Decomposed by hydrochloric acid.

Biotite is the commonest of all the micas. It is a prominent constituent of many igneous rocks, and also of gneisses and schists. It is present as a rock-forming mineral in every county.

Alpine County: Black biotite from quartz-monzonite 1 km southwest of Bloods Station was analyzed by Valentine, Turner (99a).

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	SrO	BaO	MgO
35.62	2.61	15.24	4.69	13.67	0.74	0.95	tr.	0.26	12.70

Li_2O	Na_2O	K_2O	H_2O at 105°	H_2O ab. 105°	P_2O_5	F
tr.	0.50	7.72	0.94	4.36	none	none = 100.00%

Amador County: Biotite from a pyroxene gneiss on the North Fork of Mokelumne River above the mouth of the Bear River, was analyzed by Valentine, Turner (99a).

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	SrO	BaO	MgO	Li_2O
36.62	3.03	14.37	4.04	17.09	0.40	1.48	tr.	0.33	9.68	tr.

Na_2O	K_2O	H_2O at 105°	H_2O ab. 105°	P_2O_5	F	O = F
0.45	8.20	0.90	3.26	none	0.10	99.95 — .04 = 99.91%

Mariposa County: 1. Black biotite from biotite-granite of El Capitan, Yosemite Valley, was analyzed by Valentine; and, 2. Biotite from quartz-monzonite on Tioga road, southeast of Mount Hoffman, was analyzed by Hillebrand, Turner (99a).

	SiO_2	TiO_2	Al_2O_3	V_2O_3	Cr_2O_3	Fe_2O_3	FeO	MnO
1.	35.64	1.12	18.62	---	---	5.54	14.60	0.79
2.	35.75	3.16	14.70	0.05	tr.	4.65	14.08	0.45

	NiO	CoO	CaO	SrO	BaO	MgO	Li_2O	Na_2O
1.	---	---	0.90	---	tr.	9.72	tr.	0.38
2.	0.02		0.17	?	0.12	12.37	---	0.32

	K_2O	H_2O at 100°	H_2O ab. 100°	P_2O_5	F	O = F
1.	9.22	0.48	2.54	0.20	0.26 = 100.01	— 0.11 = 99.90%
2.	9.19	1.03	3.64	0.03	0.17 = 99.90	— 0.07 = 99.83%
						G. = 3.05.

Monterey County: The following analysis of biotite from the granite of the Monterey Peninsula has been published by Galliher (35).

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	K_2O	H_2O+
36.25	18.25	6.35	17.09	9.01	0.79	8.68	2.70 = 99.12%

Riverside County: Biotite is a constituent of the granodiorite at Crestmore, Eakle (17). It was found with carbonate rocks of the Eagle

Mountains. Long and slender rods and plates of black biotite occur in a granitic rock, in the city quarry at Riverside.

San Diego County: Fairly large plates of black biotite occur near Jacumba, and occasionally in some of the gem-bearing pegmatites at Pala. Biotite was found in the Victor mine, Rincon, as thin, dark-brown, inelastic, cleavable plates about 3 cm. in diameter, Rogers (10).

PHLOGOPITE

Hydrous potassium, magnesium, and aluminum silicate, $(OH)_2KMg_3(AlSi_3O_{10}.)$

Monoclinic. Prismatic. Usually six-sided plates and scales. Cleavage perfect basal. Tough and elastic. Pearly luster. Color yellowish-brown to brownish-red; sometimes greenish or colorless. H. = $2\frac{1}{2}$ — 3. G. = 2.78 — 2.85.

Reactions the same as for biotite.

Phlogopite is a mica similar to biotite, but containing little or no iron.

Inyo County: Phlogopite occurs with scheelite in calc-hornfels at Deep Canyon, west of Bishop.

Madera County: Phlogopite occurs with the magnetite deposit at Iron Mountain, Erwin (34).

Riverside County: A few flakes of phlogopite have been observed in the white limestone of Chino Hill, at Crestmore, Eakle (17).

LEPIDOLITE—Lithia Mica

Hydrous potassium, lithium, and aluminum silicate, $K_2Li_3Al_3(OH,F)_4(AlSi_3O_{10})_2$.

Monoclinic. In aggregates of short prisms. Commonly in scaly masses; sometimes in broad plates. Cleavage perfect basal. Vitreous to pearly luster. Color gray, lilac, lavendar, violet-blue, pink to colorless. H. = $2\frac{1}{2}$ — 4. G. = 2.8 — 3.3.

Easily fusible to a white globule, and shows the red flame of lithium. Nearly insoluble in acids. A small amount of water which reacts acid is obtained in a closed tube by intense ignition.

Lepidolite is the characteristic mica of pegmatitic veins which carry red and green tourmaline.

Inyo County: Pink lepidolite with muscovite occurs in the Half Dollar mine.

Riverside County: Lepidolite occurs with tourmaline, beryl, and amblygonite at the Fano mine, on the north side of Coahuila Mountain, Kunz (05).

San Diego County: Lepidolite, ranging in color from gray through lavender, and rose to deep-violet, is the common mica associated with the gem tourmaline of the county, Fairbanks (93a). Good crystals were found 4 miles east of Ramona having the forms: (001), (010), (100), (023), (112), $(\bar{1}11)$, $(\bar{1}31)$, (261), $(\bar{1}32)$, (130), $(\bar{2}23)$?, $(\bar{2}21)$?, $(\bar{1}12)$?, Schaller (05b). Coarse and fine scaly lepidolite is common at the Victor mine, Rincon, and crystals have the forms (001), (100), (010), and $(\bar{1}31)$, Rogers (10). The lepidolite of Pala

and Mesa Grande has been analyzed by Schaller, Clarke (10). 1. Red-purple from the Tourmaline Queen mine, Pala; 2. Blue-purple from Pala; 3. Purple; 4. White; 5. Lepidolite border on muscovite from Mesa Grande.

	SiO_2	Al_2O_3	Fe_2O_3	FeO	Mn_2O_3	MnO	MgO	CaO	Li_2O	Na_2O
1.	51.12	22.70	0.80	---	1.34	---	---	---	5.12	2.28
2.	50.95	23.97	0.82	---	1.29	---	---	---	4.63	2.39
3.	50.34	28.71	0.11	tr.	---	0.50	none	tr.	2.39	1.59
4.	51.25	25.62	0.12	none	---	0.05	none	tr.	4.31	1.94
5.	50.85	26.78	0.60	---	---	0.07	tr.	0.10	4.27	1.41

	K_2O	H_2O	P_2O_5	F		O=F	
1.	10.60	2.05	0.04	6.38	= 102.43	— 2.69	= 99.74%
2.	10.69	1.91	0.04	6.11	= 102.80	— 2.57	= 100.23%
3.	10.37	3.15	---	5.02	= 102.18	— 2.11	= 100.07%
4.	10.65	1.60	---	7.06	= 102.60	— 2.97	= 99.63%
5.	10.30	1.74	---	6.71	= 102.83	— 2.82	= 100.01%

Kennard and Rambo (33) found 0.67% rubidium oxide, 0.16% cesium oxide and spectroscopic traces of gallium and thallium in lepidolite from the Sickler mine at Pala.

GLAUCONITE

Essentially a hydrous iron and potassium silicate.

Monoclinic. Cryptocrystalline or granular. Cleavage (001) perfect. Dull or glistening luster. Color olive-green, blackish-green, yellowish-green, grayish-green. H. = 2. G. = 2.2 — 2.4.

Fuses easily to a dark magnetic glass. Some varieties are entirely decomposed by hydrochloric acid, while others are not appreciably attacked. Yields water.

It is found abundantly in ocean sediments near the continental shores.

Butte County: Glauconite occurs in the Ione sandstone at Chambers Ravine, 4 miles north of Oroville, Allen (29).

Los Angeles County: It was found in siliceous shale near Redondo, Reed (28).

Monterey County: It was found by dredging in Monterey Bay. Two analyses of the glauconite supposedly formed by alteration of biotite have been published by Galliher (35).

Glauconite	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	H_2O+
Firm	55.95	11.56	9.99	2.02	6.77	3.95	0.61	4.12	3.22
Spongy	51.90	1.52	27.98	1.26	4.67	0.89	0.53	4.90	4.05

	H_2O-	P_2O_5	Org. mat.
Firm	1.60	0.18	tr. = 99.97%
Spongy	2.10	0.11	tr. = 99.91%

COOKEITE

Hydrous lithium and aluminum silicate, $(Li,Al)_4(Si,Al)_4O_{10}(OH)_4.2H_2O$.

Monoclinic. In pseudo-hexagonal plates; rounded aggregates. Micaceous cleavage. Color white, yellowish, pale-pink, deep-pink. H. = $2\frac{1}{2}$. G. = 2.67.

Fuses and exfoliates before the blowpipe.

San Bernardino County: Cookeite has been reported from Oro Grande.

San Diego County: Cookeite from Pala has been analyzed by Schaller, Clarke (10).

SiO_2	Al_2O_3	MnO	MgO	CaO	Li_2O	Na_2O	K_2O
35.53	44.23	tr.	tr.	tr.	2.73	2.11	0.31

H_2O at 105°	H_2O ab. 105°	F		O = F	
0.61	13.57	1.46	= 100.55	— 0.61	= 99.94%

Colorless and deep pink cookeite is found in pockets at the Victor mine, Rincon, coating quartz, lepidolite, orthoclase, albite, and kunzite, and as pseudomorphs after kunzite, Rogers (10).

GANOPHYLLITE

Hydrous manganese and aluminum silicate, $7MnO.Al_2O_3.8SiO_2.6H_2O$.

Monoclinic. Tabular crystals. Perfect basal cleavage. Vitreous luster. Color yellowish to brown. H. = 4 — 4½. G. = 2.84.

Easily fusible. Gives green bead of manganese with sodium carbonate. Soluble in strong acid.

Santa Clara County: Ganophyllite was one of the minerals of the manganese boulder found near Alum Rock Park, 5 miles east of San Jose. It occurred in seams with barite, as brownish-yellow tabular crystals, Rogers (19a).

AMPHIBOLE GROUP

ANTHOPHYLLITE

Magnesium and iron silicate, $(OH)_2(Mg,Fe)_7Si_8O_{22}$.

Orthorhombic. Prismatic. Commonly lamellar or fibrous massive. Cleavage perfect prismatic. Vitreous luster. Color brownish-gray, brownish-green. Streak uncolored or grayish. H. = 5½ — 6. G. = 2.85 — 3.2.

B. B. fuses to a black magnetic enamel. Insoluble in acids.

Anthophyllite is a metamorphic mineral that occurs in schists and gneisses.

Contra Costa County: Fibrous masses of anthophyllite occur in the schists near San Pablo, and the mineral has been analyzed by Blasdale (01). The analysis shows the mineral to be somewhat serpentinized.

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	H_2O at 100°	H_2O ab. 100°	Mno
33.66	1.36	0.34	4.80	38.70	0.48	0.98	0.24	19.70	tr. = 100.26%

Riverside County: It occurs with tremolite and actinolite in the Eagle Mountains.

San Bernardino County: It occurs in the Slate Range, Hanks (84).

Trinity County: Soda-rich anthophyllite asbestos, occurring in serpentine from Coffee Creek, 1 mile north of Carrville, has been analyzed by Laudermilk, Laudermilk and Woodford (30).

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	MnO
57.70	absent	2.00	tr.	5.32	21.12	5.10	7.40	absent	tr.

F	H_2O+	H_2O-
absent	1.80	0.30 = 100.74%

AMPHIBOLE

Complex silicate, $(OH,F)_2(Ca,Na)_{2-3}(Mg,Fe,Al,Mn,Ti)_5(Si,Al)_8O_{22}$.

Monoclinic. Crystals prismatic. Also columnar, fibrous, granular massive. Cleavage perfect prismatic. Brittle. Vitreous to pearly luster. Color white, gray, green, brown, black. Streak uncolored or pale. H = 5 — 6. G = 2.9 — 3.4.

The pyrognostics of hornblende and other amphiboles are essentially the same as for the corresponding varieties of pyroxene.

The amphiboles are very important rock-forming minerals. They occur in metamorphic and igneous rocks, and the common varieties are found in every county.

Cummingtonite is a magnesia-iron amphibole, $(Mg, Fe)_7 Si_8O_{22}(OH)_2$. It occurs in brown fibrous or lamellar masses, and is similar to anthophyllite. G. = 3.1 — 3.4.

Tremolite is a lime-magnesia amphibole, $(OH)_2Ca_2Mg_5Si_8O_{22}$. It is common as a metamorphic mineral in schists and crystalline limestones, occurring as white or gray long prismatic and fibrous aggregates. G. = 2.9 — 3.2.

Tremolite or actinolite may assume the fibrous form of *asbestos*. Much of the asbestos of the State is, however, serpentine asbestos.

Mountain cork and *Mountain leather* are white to gray, cork-like and leathery masses of tremolite.

Actinolite is a lime-magnesia-iron amphibole, $(OH)_2Ca_2(Mg, Fe)_5Si_8O_{22}$. It is very abundant in the schists of the Coast Ranges and the Sierra Nevada. It is generally found in bright to dark-green long prismatic and fibrous aggregates. G. = 3 — 3.2.

Smaragdite is an emerald-green foliated variety of actinolite.

Edenite is a white to light-green aluminous variety of amphibole.

Pargasite is a light to dark-green aluminous variety of amphibole.

Hornblende is the commonest of the amphiboles and is found in dark-green or black fibrous and granular masses. Hornblende is characteristic of the acid and intermediate igneous rocks, while augite is characteristic of the basic eruptives. It is variable in composition and rather rich in aluminum. It forms large areas of schists or amphibolites, and is also a constituent of granite, syenite, diorite, rhyolite, and trachyte. It is less common in gabbro, diabase, and basalt.

Uralite is a white to pale- or deep-green amphibole derived by the alteration of pyroxene. The process of change from pyroxene to amphibole is called uralitization.

Amador County: Sheets of mountain leather with mountain cork have been found in the Little Grass Valley mine at Pine Grove. Some asbestos occurs near Oleta.

Butte County: Hornblende is the most abundant constituent of a quartz-amphibole diorite on the ridge between Butte and Plumas counties; it has been analyzed by Valentine, Turner (96), (98).

SiO_2	TiO_2	Al_2O_3	Cr_2O_3	Fe_2O_3	FeO	MnO	CaO
50.08	0.76	7.97	0.16	2.69	6.71	0.49	11.21

MgO	Na_2O	K_2O	H_2O	P_2O_5
16.31	1.22	0.46	1.40	tr. = 99.46%

Tremolite asbestos occurs in limestone on Berry Creek. It was reported from near Blinzig.

Calaveras County: Hornblendite, a rock consisting wholly of coarse hornblende, occurs in patches on Carson Hill, Moss (27). A large body of hornblende rock exists just west of Vallecito, along the road to Angels Camp. Large crystals of hornblende occur in the country rock of the Shenandoah mine, 10 miles northeast of San Andreas. Actinolite is common near Valley Springs.

Contra Costa County: Tremolite and actinolite are common in the schists north of Berkeley and near San Pablo. They have been analyzed by Blasdale (01).

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO
Tremolite	56.68	1.79	1.70	2.23	19.35	15.80
Actinolite	55.21	3.45	---	7.49	18.97	10.50
	55.56	2.05	---	5.97	19.45	12.13

	Na_2O	K_2O	H_2O at 100°	H_2O ab. 100°
Tremolite	---	---	0.10	2.25 = 99.90%
Actinolite	2.45	---	---	1.75 = 99.82%
	1.94	0.30	---	2.58 = 99.98%

Del Norte County: Tremolite is found near Diamond Creek.

El Dorado County: Large cleavage masses of black hornblende occur with orthoclase, bornite, molybdenite, epidote, and axinite at the old Cosumnes Copper mine, near Fairplay. Bladed crystals of green actinolite occur in the schists near Latrobe. Short white fibers of asbestos occur near Georgetown.

Fresno County: Large crystals of hornblende in massive hornblende rock occur at the Cinnamon Bear mine, near Pine Flat. Asbestos is reported to occur 30 miles east of Sanger.

Humboldt County: Massive hornblende occurs west of Three Creeks, near Horse Mountain. Actinolite schist with chlorite occurs at Briceland.

Inyo County: Masses of mountain cork are found in the Swansea district and in Craigs Canyon on the eastern slope of the Inyo Mountains.

Kern County: Mountain leather occurs near Keene. Actinolite and tremolite occur in schists near Randsburg. Large columnar, brittle tremolite occurs at Toll Gate Canyon. Mountain cork occurs at the Tom Reed mine. Actinolite occurs in a contact metamorphic rock a quarter of a mile east of Hobo Hot Springs.

Los Angeles County: Crystalline masses of tremolite occur in calcite in the Upper San Gabriel mining district.

Madera County: Tremolite occurs with piedmontite and quartz 300 yards east of the outlet of Shadow Lake, Short (33). Coarse aggregates of actinolite occur in metamorphosed limestone on Shadow and Johnston Creeks; large prismatic crystals of actinolite occur in the magnetite deposit on the western slope of Iron Mountain, Erwin (34). Asbestos occurs at the Savannah mine, Grub Gulch, and at the Baker mine, near Coarse Gold. Actinolite schists carrying pyrrhotite and chalcopyrite occur at the Heiskell mine.

Marin County: Actinolite is common in the lawsonite schist of Reed Station. Massive black hornblende occurs with lawsonite near Reed Station. Actinolite occurs in the schists on Angel Island.

Mariposa County: Hornblende is a constituent of: 1, the gabbro of Beaver Creek, near Big Trees; and, 2, of a quartz-monzonite on Tioga road, southeast of Mount Hoffman, Turner (96), (99a). The first has been analyzed by Valentine and the second by Hillebrand.

	SiO_2	TiO_2	Al_2O_3	V_2O_3	Fe_2O_3	FeO	MnO	NiO	CaO	MgO
1.	46.08	0.77	10.56	---	2.81	8.30	0.15	---	12.64	14.40
2.	47.49	1.21	7.07	0.04	4.88	10.69	0.51	0.02	11.92	13.06

	Na_2O	K_2O	Li_2O	H_2O at 100°	H_2O ab. 100°	P_2O_5	F		O = F	
1.	1.62	0.34	none	0.17	1.97	0.18	none =	99.99%		
2.	0.75	0.49	tr.	---	1.86	none	0.06 =	100.05	— .02	= 100.03%

Some asbestos occurs east of the Mariposa Grant. Boulders consisting mainly of large hornblende crystals occur near El Portal.

Mendocino County: Actinolite occurs at Calpella. Large masses of good actinolite prisms occur near Potter Valley.

Mono County: Long prisms of hornblende occur in the cavities of lava 8 miles west of Bridgeport, with forms: (001), (010), (100), (110), ($\bar{2}01$), (021), and ($\bar{1}31$), Schaller (05a).

Monterey County: Actinolite is found in the schists near Soledad.

Napa County: Tremolite occurs in Chiles Valley.

Nevada County: Hornblende occurs in large crystals in the granodiorite of Nevada City and Grass Valley, Lindgren (96). Uralite is common in the diorite of this locality. Large cleavage prisms of hornblende in schist occur in the Birchville district. Hornblende from granodiorite at the head of Rattlesnake Creek, Colfax Quadrangle, has been analyzed by Willmann, Pabst (28).

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O
49.05	0.90	7.14	7.72	10.49	---	11.45	10.77	1.20	0.68
					P_2O_5	H_2O+	H_2O-		
					---	0.33	--- = 99.73%		G. = 3.17

Placer County: Large masses of asbestos are found at Wisconsin Hill and Arizona Flat. Long white fibers of asbestos occur a quarter of a mile east of Iowa Hill. Long silky fibers of white to light-green asbestos are found south of Towle.

Plumas County: Edenite is a constituent of the plumasite of Spanish Peak, Lawson (03). Actinolite and hornblende occur at Engels as rock constituents. Good-fibered asbestos occurs at the Fireproof Asbestos mine, near Sloat. Green asbestos is found near Spring Garden.

Riverside County: Actinolite, tremolite, and anthophyllite occur in the schist of the Eagle Mountains. A good deposit of asbestos is reported 15 miles southeast of Palm Springs. Fine dark-green crystals of horneblende occur in a quartz-feldspar vein just west of the Jensen Limestone quarry, 4 miles west of Riverside. Tremolite occurs with calcite and gypsum at the Midland mine of the U. S. Gypsum Company, in the Little Maria Mountains.

San Benito County: Actinolite occurs in capillary bunches in the veins and wall-rock at the Benitoite mine, near the headwaters of the San Benito River, Louderback (09). Good specimens have come from Tres Pinos.

San Bernardino County: Tremolite is found in a large vein of talc 7 miles northeast of Silver Lake, Wicks (30). Tremolite is common in the Furnace limestone on the northern slope of the San Bernardino Mountains, Woodford and Harriss (28). Fibrous, pale-blue, soda-tremolite occurs with diopside near the mouth of Cascade Canyon in the San Gabriel Mountains, Merriam and Laudermilk (36). Cummingtonite with calcite has been found near Daggett. Coarse fibered tremolite occurs in the Oro Grande district.

San Diego County: Large crystals of black hornblende forming rock masses occur 4 miles east of Fallbrook.

Santa Clara County: Actinolite, smaragdite, and pargasite occur in the eclogites of Oak Ridge and Calaveras Valley, Murgoci (06). Pargasite from Arroyo Hondo, described by J. P. Smith (06), was analyzed by W. O. Clark:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	Mno	CaO	Na_2O	K_2O	H_2O
42.68	0.68	9.96	6.12	12.25	9.58	tr.	11.83	3.30	0.89	3.28 = 100.57%

Fibrous tremolite is found near Morgan Hill.

Santa Cruz County: Mountain leather is found in sheets up to 6 feet in diameter, in the limestone quarry of the Santa Cruz Portland Cement Company at Davenport.

Shasta County: Long fibrous white tremolite or asbestos occurs in the Stock Asbestos mine, near Sims.

Sierra County: Long fibers of asbestos occur on Goodyear Bar Creek.

Siskiyou County: Tremolite asbestos occurs in the Blue Ledge mining district. Massive bladed actinolite occurs near the mouth of Black Gulch on the South Fork of Salmon River.

Sonoma County: Large crystals of actinolite occur in foliated talc near Petaluma, W. P. Blake (66). Smaragdite occurs in the glaucophane-gneiss near Santa Rosa, Murgoci (06). Actinolite is common with glaucophane at Camp Meeker. Coarse actinolite prisms occur on the Hasey ranch, west of Cloverdale.

Trinity County: Massive hornblende occurs near Wildwood and Auto Rest. Large crystals of it are found near Trinity Center and Douglas City.

Tulare County: Asbestos occurs near Globe, and near Porterville. Tremolite and hornblende occur at the White Chief mine, near Mineral King. Very coarse prismatic crystals of hornblende occur in gabbro at the north end of Colvin Mountain, near Woodlake. Hornblende crystals up to 10 inches long occur in gabbro in the Yokohl Valley, near Exeter.

Tuolumne County: White fibrous tremolite occurs in the marble near Columbia; asbestos occurs near Chinese Camp; mountain cork occurs at Sawmill Flat and on Table Mountain.

Yuba County: Small amounts of tremolite asbestos occur near Challenge.

SODA AMPHIBOLES

GLAUCOPHANE

Monoclinic. Prismatic. Generally fibrous massive. Cleavage perfect prismatic. Vitreous luster. Color deep-blue to bluish-black. Streak grayish-blue. H. = 6 — 6½. G. = 3 — 3.15.

Fuses quietly and yields a strong yellow flame of sodium. Insoluble in acid.

Glaucophane, a soda-amphibole rich in alumina and containing little water, is a constituent of metamorphic rocks high in sodium. It was noted in California at least as early as 1878, Rolland (78). Extensive areas of glaucophane rocks exist in California along the Coast Range and have been described by Becker (88), Ransome (95), Lawson (93), Palache (94a), J. P. Smith (06), Murgoci (06), Hanks (84), Holway (04), and others.

Crossite was the name given by Palache (94a) to a blue soda amphibole which differs from glaucophane in having a higher iron content. G. = 3.16.

Riebeckite is a dark-blue to black soda-amphibole rich in ferric iron. G. = 3.4.

Crocidolite is a blue fibrous soda-amphibole similar to riebeckite in composition. G. = 3.2-3.3.

Kataphorite is a brownish amphibole associated and sometimes classed with the soda amphiboles.

Barkevikite is a deep velvet-black soda-amphibole rich in iron. It resembles hornblende, and is characteristic of certain syenites. G.=3.43.

Contra Costa County: The glaucophane from the schists near San Pablo was analyzed by Blasdale (01).

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	NA_2O	K_2O	H_2O	TiO_2	MnO	
54.52	9.25	4.44	9.81	10.33	1.98	7.56	0.16	1.78	0.39	0.46	= 100.68%
52.39	11.29	3.74	9.13	11.37	3.03	6.14	tr.	2.57	0.14	tr.	= 99.80%

Crossite was found with albite in a boulder on a hillside north of Berkeley, and was described by Palache (94a) as a new amphibole. Analysis by W. S. T. Smith.

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	H_2O	
55.02	4.75	10.91	9.45	tr.	9.30	2.38	7.62	0.27	undet.	= 99.70%

Fresno County: Glaucophane is common in the Coast Range from Coalinga to Livermore Pass.

Barkevikite is an important constituent of syenite, near the head of White Creek, about 16 miles northwest of Coalinga, Arnold and Anderson (10).

Humboldt County: Glaucophane occurs above Orleans on the Klamath River and on the east side of Jacoby Creek above Bayside.

Lake County: Masses of glaucophane have been found in the mountains near Upper Lake. Fibrous veins of crocidolite are reported to occur in schist near Lakeport.

Los Angeles County: Glaucophane is a common constituent of the schists on Santa Catalina Island and on San Pedro Hill. Crossite schist occurs on San Pedro Hill, Woodford (24).

Marin County: Glaucophane is common in the schists near Reed Station, Ransome (95) and on Angel Island, Ransome (94).

Mendocino County: Glaucophane is common near Calpella. It occurs with hornblende, biotite, and quartz at Longvale. Crossite occurs as a constituent of schist near the headwaters of Jumpoff Creek.

Monterey County: Glaucophane and crocidolite occur in schists near Pleyto.

Napa County: Glaucophane occurs in schist near Calistoga.

Plumas County: Crocidolite and kataphorite occur in the syenite of Spanish Peak, Murgoci (06).

San Benito County: A glaucophane resembling crossite occurs in the benitoite-natrolite vein near the headwaters of the San Benito River. It was analyzed by Blasdale, Louderback (09).

SiO_2	Al_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	H_2O at 100°	H_2O ab. 100°
52.94	3.76	13.40	1.44	11.54	5.45	5.11	0.43	1.31	3.72 = 99.10%

San Diego County: Glaucophane and crossite occur in schist boulders in the San Onofre breccia, Woodford (25).

Santa Clara County: Murgoci (06) mentions glaucophane as a constituent of eclogite, quartzite, mica schist, and greenstone in Calaveras Valley. Kataphorite is a constituent of diorite at Oak Ridge, Calaveras Valley, Murgoci (06). Crocidolite occurs as bluish fibrous seams in metamorphic rock east of Mount Hamilton. Schellinger's analysis of it is given by Rogers (12).

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O (by diff.)	H_2O
50.65	0.90	19.21	21.70	0.79	0.39	4.93	1.43 = 100%

Sonoma County: Glaucophane occurs with actinolite, garnet, epidote, and quartz in schist near Healdsburg. It was found at Camp Meeker and near Petaluma.

Stanislaus County: Glaucophane occurs in schist east of Red Mountain.

Trinity County: Glaucophane occurs near Hayfork.

Tulare County: Riebeckite occurs in bundles of acicular crystals with garnet and actinolite in a contact metamorphic rock in the E$\frac{1}{2}$ Sec. 28, T. 19 S., R. 27 E., M. D. M., in the Rocky Hill district, near Exeter.

Tuolumne County: Radiating groups of acicular riebeckite occur abundantly near the Clio mine, half a mile east of Jacksonville, Knopf (29).

SERPENTINE

Hydrous magnesium silicate, $H_4Mg_3Si_2O_9$.

Monoclinic. Commonly massive, compact to fibrous. Cleavage (010) distinct. Subresinous luster. Color leek-green to blackish-green, brownish and nearly white. Streak white. Feels smooth, sometimes greasy. H. = $2\frac{1}{2}$ — 4. G. = 2.21 — 2.65.

Fusibility = 6. Soluble in hydrochloric acid, but without forming a jelly. Gives water in a closed tube. A heavy precipitate of magnesia is obtained by sodium phosphate.

Serpentine is one of the commonest minerals, as well as one of the rocks of the State. It is an alteration product of basic igneous rocks rich in magnesian silicates. Besides the ordinary massive serpentine, *marmolite, chrysotile, picrolite,* and *williamsite* have been found in California. The only variety of commercial importance is the fibrous or asbestiform variety known as chrysotile, or chrysotile asbestos, which occurs as narrow veins in the massive material, mostly too narrow to be of value. The massive serpentine ranges in color from light green to greenish black, but very little of it can be utilized as an ornamental stone on account of its foliated and sheared structure.

Serpentine is abundant in the Coast Range from Del Norte to San Diego County, and on the west flank of the Sierra Nevada.

Amador County: A fine mottled serpentine occurs $1\frac{1}{2}$ miles west of Sugar Loaf Mountain. Broad sheets and long fibers of chrysotile occur in serpentine in the American River Canyon, near Towle. A deposit of chrysotile has been quarried 2 miles west of Plymouth. Veins of chrysotile occur in a dark-green serpentine at the Mace mine, $2\frac{1}{2}$ miles east of Ione.

Calaveras County: Veins of chrysotile occur in the serpentine of the ridge northwest of the Stanislaus River, about 6 miles southeast of Copperopolis.

El Dorado County: Veins of fibrous chrysotile are found at Forest Hill. A good quality of fibrous chrysotile occurs near Georgetown.

Fresno County: Serpentine containing veinlets of chrysotile occurs near Lanare.

Inyo County: Long fibers of serpentine asbestos occur at Cerro Gordo.

Kern County: Chrysotile veins occur in serpentine in Jawbone Canyon.

Lake County: Becker (88) gives analyses by Melville of the serpentine at Sulphur Bank. 1. Black; 2. Light green.

	SiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	NiO	CaO	MgO	H_2O
1.	39.64	1.30	0.29	7.76	0.12	0.33	---	37.13	13.81 = 100.38%
2.	41.86	0.69	0.24	4.15	0.20	tr.	---	38.63	14.16 = 99.93%

Fibrous chrysotile in serpentine occurs 8 miles southeast of Lower Lake. It occurs near Siegler Springs and in the mountains near Bartlett Springs.

Los Angeles County: Serpentine marble has been quarried commercially on Santa Catalina Island.

Mariposa County: Small veins of chrysotile occur in the serpentine near Mariposa.

Monterey County: Fibrous chrysotile occurs near Pleyto.

Napa County: Chrysotile asbestos in short fibers occurs in Steel Canyon.

Nevada County: Massive serpentine is common in the Grass Valley and Nevada City region. Zones of short fibrous chrysotile occur in the Washington district on the South Fork of Yuba River. Picrolite occurred in the Maryland mine, Grass Valley.

Placer County: Long fibers of chrysotile occur at Wisconsin Hill, Iowa Hill, and Arizona Flat.

Plumas County: Diller (98) gives an anlysis of serpentine from Greenville by Melville.

SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	H_2O
39.14	2.08	4.27	2.04	tr.	39.84	12.70 = 100.07%

Riverside County: Small grains of serpentine occur in the white crystalline limestone at Crestmore, Eakle (17). Yellowish-green nodular masses occur in crystalline limestone on the Eagle Mountains.

San Benito County: Becker (88) gives an analysis of a light-green marmolite from New Idria by Melville.

SiO_2	Al_2O_3	FeO	NiO	CaO	MgO	H_2O
41.54	2.43	1.37	0.04	---	40.42	14.18 = 100.03%

Short-fiber chrysotile has been mined commercially near New Idria.

San Francisco County: Newberry (74) gives an analysis of the serpentine of San Francisco.

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	H_2O
39.60	1.94	0.20	8.45		---	36.90	12.91 = 100%

Santa Clara County: Small veins of chrysotile occur in the serpentine near New Almaden. Picrolite occurs near Morgan Hill.

Shasta County: Large fibrous masses of chrysotile asbestos occur near Sims Station. Massive serpentine containing chrysotile asbestos veinlets is found about 3 miles east of Castella Station.

Sierra County: Serpentine asbestos occurs on the west bank of Goodyear Creek.

Siskiyou County: Massive serpentine occurs on a ridge in the Cottonwood Mountains. at the head of Bogus and Dutch Creeks. Williamsite, or gem serpentine, occurs near Indian Creek, north of Happy Camp on the Klamath River, Melhase (34). Chrysotile asbestos occurs west of Edgewood.

Sonoma County: Fibrous veinlets of asbestos occur in the serpentine near Petaluma and Sebastopol.

Trinity County: Chrysotile has been mined at the Jones Brothers Asbestos mine, 2 miles northwest of Carrville, Averill (31).

Tulare County: Chrysotile is found in the serpentine east of Lindsay.

Tuolumne County: The serpentine near Chinese Camp contains small veins of chrysotile.

PYROXENE GROUP

ENSTATITE

Magnesium silicate, $MgSiO_3$.

Orthorhombic. Prismatic. Generally massive, lamellar. Cleavage perfect prismatic. Brittle. Pearly to vitreous luster. Color greenish or brownish-gray to brown. Streak uncolored, grayish. H. = 5½. G. = 3.1—3.3.

Practically infusible and insoluble. Its constituents can be determined only in the wet way.

Enstatite is a rock-forming mineral which is characteristic of gabbros, and rocks that have been derived from gabbros, like much of the serpentinized rocks of the Coast Range and Sierra Nevada. It is a common mineral, but has seldom been mentioned.

Bronzite is a variety in which part of the magnesium is replaced by iron. It occurs in bronze-brown reticulated masses.

Alameda County: Bronzite occurs in some of the rocks of the Berkeley Hills, Hanks (84).

Contra Costa County: Massive enstatite is found in the Diablo Range in this and other counties to the south.

Kern County: Bronzite was one of the constituents of the San Emigdio meteorite, and was analyzed by Whitfield (90).

SiO_2	FeO	MgO	CaO
54.42	14.03	29.11	2.46=100.02%

Mariposa County: Massive bronzite occurs in the gabbriotic rock of the old Mariposa estate.

Nevada County: Enstatite is a constituent of the gabbros of Nevada City, Lindgren (96).

Plumas County: Enstatite and bronzite are constituents of the noritic rock at Engels.

San Francisco County: Enstatite occurs abundantly in the serpentine of San Francisco, W. P. Blake (58), Lawson (93), Palache (94), Eakle (01).

San Luis Obispo County: It was found in the serpentine at San Simeon.

Stanislaus County: Enstatite with actinolite has come from near Patterson.

Trinity County: It was observed in the rock near Trinity Center. Bronzite occurs near Hyampom.

Tulare County: It has been observed in rock near Lindsay.

Tuolumne County: Light-green enstatite occurs in the gabbro near Jamestown and also near Jacksonville.

HYPERSTHENE

Iron and magnesium silicate, $(Fe,Mg)SiO_3$.

Orthorhombic. Prismatic; often tabular. Generally massive, foliated. Cleavage (110) distinct. Brittle. Pearly to vitreous luster. Color brownish-green to brown. Streak grayish. H. = 5 — 6. G. = 3.4 — 3.5.

B. B. fuses to a black enamel and on charcoal yields a magnetic mass. Partially decomposed by hydrochloric acid.

Hypersthene is a constituent of basic eruptive rocks, especially gabbros and andesites.

Plumas County: Hypersthene is a constituent of the hypersthene andesite at La Porte, Turner (94a). It is one of the constituents of the norite rock at Engels.

San Diego County: It is one of the minerals in the orbicular gabbro at Dehesa, Lawson (93).

San Francisco County: It is a constituent of the dikes cutting the serpentine of the Potrero, San Francisco, Palache (94).

Siskiyou County: It is mentioned by J. D. Dana (49a) as a constituent of the hypersthene andesite of Mount Shasta.

PYROXENE

Calcium and magnesium silicate, $CaMg(SiO_3)_2$ with or without Fe,Al, and Na.

Monoclinic. Prismatic crystals. Coarsely lamellar. Also coarse or fine granular. Cleavage perfect prismatic. Brittle. Vitreous luster. Color green, white, brown, black. Streak white to grayish-green. H.=5—6. G.=3.2—3.6.

Fusibility varies with amount of iron. Varieties rich in iron give a magnetic globule when fused on charcoal. Most varieties are insoluble in acids.

Diopside is a lime-magnesia pyroxene, $CaMg(SiO_3)_2$. It is white to deep grass-green, and is characteristic of crystalline limestones, metamorphosed eruptives, and some schists. G.=3.28.

Violan is a violet-colored diopside.

Diallage is a lamellar or fibrous pyroxene near diopside in composition. It is characteristic of gabbros.

Hedenbergite is a black lime-iron pyroxene, $CaFe(SiO_3)_2$. G.=3.6.

Omphacite is a granular non-aluminous pyroxene. It is characteristic of eclogites in association with garnet.

Augite is a dark-green to black aluminous pyroxene. It is the commonest of all the pyroxenes, and is an essential constituent of diorites, gabbros, diabases, basalts, andesites, pyroxenites, and other basic eruptives. It is mentioned in all petrographic descriptions of basic igneous rocks. G.=3.22.

Contra Costa County: Diopside is common in the schists with albite near San Pablo and has been described and analyzed by Blasdale (01).

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO
Fresh	51.91	3.55	1.30	2.65	16.15	22.85
Altered	49.62	2.97	2.49	2.99	19.72	19.14

	Na_2O	H_2O at 100°	H_2O ab. 100°	TiO_2	MnO	
Fresh	0.56	0.21	0.86	0.10	0.33	=100.47%
Altered	0.60	---	2.71	---	---	=100.24%

Diallage is a constituent of gabbro on Mount Diablo.

El Dorado County: Fine dark-green crystals of diopside occur near Mud Springs. It occurs in good crystals at the Cosumnes Copper mine.

Inyo County: Masses of diopside have come from the Panamint Mountains. Pale-green diopside is a prominent constituent of metamorphic rocks at Round Valley on the north side of the Tungsten Hills, 6 miles west of Bishop, Chapman (37).

Lake County: Violan occurs in Big Canyon.

Los Angeles County: Large light-green crystals of diopside are found near San Pedro.

Madera County: Diopside occurs in silicified limestone on Shadow and Johnson Creeks near the northeast corner of the county, Erwin (34).

Nevada County: Diallage is a constituent of the gabbro at Nevada City and Grass Valley, Lindgren (96).

Plumas County: Diallage occurs in gabbro near Grizzly Peak, Turner (94a).

Riverside County: Crystals of pale-green diopside occur in the limestone at Crestmore, and were described by Eakle (17). Forms observed were: (001), (010), (100), (110), (011), (021), (111), (221), ($\bar{1}$12), ($\bar{1}$11), ($\bar{2}$21), ($\bar{3}$31), (131), (121), ($\bar{2}$31), ($\bar{2}$11), ($\bar{1}$21), ($\bar{3}$52), ($\bar{7}$53), ($\bar{8}$63), ($\bar{1}\bar{4}$.3.10), and (10.12.7). A deep-green pyroxene resembling omphacite occurs associated with cinnamon garnet at the Crestmore quarry. Augite is a constituent of the quartz-monzonite porphyry of the quarry. A white pyroxene occurs in the dolomitic limestone of the Eagle Mountains. A very pure pale-green diopside from the Wet Weather quarry at Crestmore has been analyzed by Merriam, Merriam and Laudermilk (36).

SiO_2	CaO	MgO	FeO	Fe_2O_3	Al_2O_3	H_2O+	H_2O-
54.54	24.76	17.23	0.30	0.93	1.28	0.64	0.32 = 100.00%

San Bernardino County: Snow-white, fine-grained diopside occurs near the mouth of Cascade Canyon in the San Gabriel Mountains, in the SE¼ Sec. 36, T. 2 N., R. 8 W., S. B. M., and has been analyzed by Laudermilk, Merriam and Laudermilk (36).

SiO_2	CaO	MgO	Fe_2O_3	Al_2O_3	H_2O+	H_2O-
56.50	25.56	17.80	0.24	0.12	0.58	0.22 = 101.02%

San Francisco County: Crystals of diallage occur in the serpentine of San Francisco, Erman (49), Lawson (95), Palache (94).

San Mateo County: Diallage occurs in gabbro near Crystal Springs.

Santa Barbara County: Augite as a constituent of teschenite at Point Sal was analyzed by Fairbanks (96).

SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	Na_2OK_2O	Ign.
46.59	9.69	1.03	4.75	21.38	13.89	1.23	1.22 = 99.78%
							G. = 2.338

Santa Clara County: Diallage occurs at Los Gatos Creek. Omphacite is a constituent of eclogite in the Calaveras Valley, Murgoci (06).

Shasta County: Hedenbergite occurs with ilvaite at Potters Creek, and has been analyzed by Bjorkstedt, Prescott (08a).

SiO_2	Al_2O_3	FeO	MnO	CaO	MgO
46.4	0.6	22.6	7.9	20.5	2.2 = 100.2%

Tuolumne County: Diallage occurs in the gabbro of the Rawhide ranch.

ACMITE—Aegirite

Sodium and iron silicate, essentially $NaFe(SiO_3)_2$.

Monoclinic. Prismatic crystals. (Cleavage (110) distinct. Brittle. Vitreous luster. Color brown or dark-green. Streak pale yellowish-gray. H. = 6 — 6½. G. = 3.50 — 3.55.

Fuses quietly to a globule which is slightly magnetic and gives a yellow sodium flame. Nearly insoluble.

Acmite and aegirite are rock-forming minerals prominent in some syenites.

San Benito County: A specimen of rock containing prisms of acmite was found near Hollister. Aegirite occurs in stellate groups with benitoite and natrolite in the albite at the benitoite locality near the headwaters of the San Benito River, Louderback (09).

San Diego County: It occurs with quartz, crossite, and garnet in schist boulders in the San Onofre Breccia on the State highway due west of San Onofre Mountain, Woodford (25).

SPODUMENE

Lithium and aluminum silicate $LiAl(SoO_3)_2$.

Monoclinic. Crystals prismatic, often flattened; sometimes very large. Massive, cleavage perfect prismatic. Brittle. Vitreous luster. Color greenish-white, grayish-white, emerald-green, lilac, amethystine. Streak white. H. = 6½ — 7. G. = 3.13 — 3.20.

Fuses to a clear glass and gives a red lithium flame, best seen through blue glass or through a Merwin color screen. Insoluble in acids.

Spodumene is found in large crystals and cleavage masses in pegmatitic veins, commonly associated with lepidolite and lithium tourmaline.

Kunzite is a beautiful transparent variety, lilac or amethystine in color. It is sometimes called *California iris.*

Hiddenite is an emerald-green spodumene.

Riverside County: Kunzite occurs in the San Jacinto Mountains, near Coahuila, Schaller (03a).

San Diego County: The transparent lilac variety discovered by Kunz (03) in 1903 and named kunzite by Baskerville (03), which is used as a gem, occurs in the pegmatite veins of the Pala Chief mine at Pala with the gem tourmaline, although not abundant nor in large pieces. Most of it is in flat cleavage pieces, but fair crystals have been found with the forms: (010), (100), (110), (130), (350), (320), (121), ($\bar{1}$12), Schaller (03a). It has been further described by Baskerville and Kunz (04) and analyzed by Schaller (03a) and by Davis (04).

	SiO_2	Al_2O_3	Mn_2O_3	Li_2O	Na_2O	K_2O	CaO	MgO
Schaller	64.42	27.32	0.15	7.20	0.39	0.03	---	---
Davis	64.05	27.30	---	6.88	0.30	0.06	0.80	none

	NiO	MnO	ZnO	Ign.		
Schaller	---	---	---	none	= 99.51%	G. = 3.189
Davis	0.06	0.11	0.44	0.15	= 100.15%	

A few crystals of hiddenite and some masses of white spodumene have also been found at Pala, with the kunzite, Schaller (03a).

Kunzite occurs sparingly at the Victor mine, Rincon, in tabular crystals, some of them twinned as seen by the natural etch-figures. Forms: (100), (110), (010), (320), (130), (021), (111), and ($\bar{1}11$). Rogers (10).

RHODONITE

Manganese silicate, $MnSiO_3$

Triclinic. Crystals tabular, often large. Generally massive or in grains. Cleavage perfect prismatic. Vitreous luster. Color rose-pink. Streak white. H. = 5½ — 6½. G. = 3.4 — 3.68.

Fusible. Gives a violet or wine-colored bead with borax. Slightly acted upon by acids.

Rhodonite is often present in manganese orebodies, with rhodochrosite.

Alameda County: Rhodonite occurs at the Corral Hollow manganese deposits.

Butte County: It was found with rhodochrosite on the North Fork of Feather River. It occurs with psilomelane and pyrolusite 1 mile north of the forks of Butte Creek.

Fresno County: Pink rhodonite occurs near Dunlap.

Glenn County: It occurs with psilomelane on Elk Creek.

Humboldt County: It was observed near Orleans.

Los Angeles County: Massive deep-pink rhodonite occurs on Portal Ridge, near Lancaster.

Madera County: It occurs with rhodochrosite, pyrolusite, manganite, and psilomelane near Coarse Gold. It occurs with garnet and epidote in crystalline limestone on the south side of Shadow Creek Canyon in the Ritter Range, Erwin (34).

Placer County: It occurs with rhodochrosite near Forest Hill.

Plumas County: Good red rhodonite has come from Genesee Valley and Meadow Valley. It occurred with copper at the Diadem lode, Meadow Valley, Turner (96). Good gem rhodonite has been reported to occur near Taylorsville.

Riverside County: It was found with pyrolusite and psilomelane near Elsinore.

Siskiyou County: Excellent rhodonite occurs at Sawyers Bar. Rhodonite partly altered to manganese oxides occurs near Gazelle, and on the South Fork of Salmon River. Specimens of rhodonite have come from Empire Creek; also Dutch Creek, near Gottville. Massive red rhodonite occurs on Indian Creek, near Happy Camp.

Tulare County: Coarse, massive rhodonite occurs as a contact metamorphic mineral near Lemon Cove, in the E½ Sec. 34, T. 16 S., R. 27 E., M. D. M.

Tuolumne County: It was found with pyrolusite on Rose Creek, near Columbia. It occurs as veins altering to manganese oxides 2 miles north of Sonora.

WOLLASTONITE

Calcium silicate, $CaSiO_3$

Triclinic. Crystals commonly tabular, also short prismatic. Generally in fibrous masses, also compact. Cleavage perfect macropinacoidal. Brittle. Vitreous luster. Color white, gray, rose. Streak white. H. = 4½ — 5. G. = 2.8 — 2.9.

Fuses easily and quietly to a clear glass. Soluble in hydrochloric acid usually without gelatinizing.

Wollastonite is formed as a metamorphic mineral in limestone near contacts with intrusive rocks.

Alameda County: Wollastonite has been found in the Berkeley Hills.

Amador County: It was found on the Mokelumne River, near Bear Creek, and analyzed by Hillebrand, Turner (96).

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O
50.67	0.20	6.37	0.31	0.50	trace	40.34	0.58	0.22

Na_2O	H_2O below 110°	H_2O above 110°	CO_2	
0.14	0.08	0.31	0.52	= 100.24%

Del Norte County: White divergent masses of wollastonite were found near Crescent City.

Imperial County: It was reported to occur with grossularite near the State highway, a few miles west of El Centro, Melhase (35a).

Inyo County: Wollastonite occurs at the Wilshire gold mine, 25 miles southwest of Laws, Turner (24). It occurs as bunches of radiating fibers with diopside in metamorphosed limestone at Round Valley on the north side of the Tungsten Hills, 9 miles west of Bishop, Chapman (37).

Kern County: A deposit of it occurs near Code Siding in the Rademacher district, W. W. Bradley (35). It was found outcropping along the canyon of Clear Creek between the Kern River and Walker Basin, Melhase (36a).

Lake County: White drusy wollastonite has come from Dry Creek, near Middletown. Specimens of it have come from near Glenbrook.

Napa County: White massive wollastonite occurs in Hunting Creek Canyon, near Knoxville.

Nevada County: White and pink wollastonite are found as contact minerals at Grass Valley.

Riverside County: Fibrous, columnar, and fine granular wollastonite occurs in the crystalline limestone at Crestmore as one of the contact metamorphic minerals. An analysis of the fine granular wollastonite by Eakle (17) gave:

SiO_2	Fe_2O_3	CaO	H_2O
51.77	2.12	44.85	1.02 = 99.76%

An analysis of the crystals of wollastonite by Eakle (17) gave:

SiO_2	CaO	MgO	Fe_2O_3	Ign.
50.42	48.29	0.60	0.51	0.07 = 99.89%

Forms observed on the crystals were: (001), (100), (110), (120), (320). (740), (540), (340), (140), (101), (104), ($\bar{1}$04), ($\bar{1}$03), ($\bar{1}$02), ($\bar{1}$01), ($\bar{2}$01), (011), (111), (744), (344), (144), ($\bar{7}$44), ($\bar{3}$44), ($\bar{1}$44), (122), ($\bar{1}$22), (142), ($\bar{1}$42).

Pink granular wollastonite occurs at a contact of limestone and granodiorite in the Central Avenue city quarry, Riverside. It was found at the scheelite deposit about 9 miles east of Aguanga, Hess and Larsen (21).

San Diego County: Large masses of pure white divergent-columnar wollastonite occur near Boulevard, and at Carrizo Gorge, near Jacumba.

Santa Barbara County: Divergent-fibrous masses of wollastonite having a pale-rose color have been found at Santa Ynez.

Sierra County: Bands of wollastonite and wollastonite-quartz schist occur near Sierra City, on the small north tributary of the South Fork of the North Fork of Yuba River, opposite Milton Creek.

Siskiyou County: Fine divergent specimens have come from the limestone on the Salmon River, 3 miles above Somes Bar.

Trinity County: White fibrous wollastonite occurs near Hyampom.

Tulare County: Specimens of wollastonite have come from the Upper Tule River. Massive wollastonite is found in metamorphosed limestone near Three Rivers in Sec. 16, T. 16 S., R. 28 E., M. D. M.; in Sec. 25, T. 17 S., R. 28 E., M. D. M.; and near Lemon Cove, in Secs. 11 and 14, T. 16 S., R 27 E., M. D. M.

PECTOLITE

Calcium and sodium basic silicate, $HNaCa_2(SiO_3)_3$.

Triclinic. In acicular crystals. Generally fibrous massive. Cleavage perfect macropinacoidal. Luster silky to vitreous. Brittle. Color white or gray. H. = 5. G. = 2.68 — 2.78.

Easily fusible to a clear glass and easily soluble, sometimes yielding gelatinous silica. A small amount of water is obtained in a closed tube.

White fibrous pectolite occurs as veins and patches in altered basic dikes and flows, and in serpentine.

Colusa County: Pectolite occurs with calcite and zeolites in serpentine near Wilbur Springs.

Lake County: Veins of fibrous pectolite occur with calcite in serpentine 1½ miles east of Middletown in a cut on the highway to Lower Lake.

San Francisco County: Fibrous pectolite occurs as veins in an altered dike which intersects the serpentine at Fort Point. It was described and analyzed by Eakle (01). Forms: (001), (100), (540), and (140).

SiO_2	$Al_2O_3Fe_2O_3$	CaO	Na_2O	H_2O
53.40	3.87	30.56	7.61	4.46 = 99.90%

Tehama County: A large mass of pectolite occurred in serpentine on Elder Creek and was analyzed by Eitel, Preston (90).

SiO_2	$Al_2O_3Fe_2O_3$	MgO	CaO	Na_2O	K_2O
56.84	1.27	0.64	33.46	3.45	3.97 = 99.63%

NEPTUNITE

Sodium, potassium, iron, and manganese titano-silicate, $(Na,K)_2(Fe,Mn)TiSi_4O_{12}$.

Monoclinic. Prismatic crystals. Cleavage (110). Vitreous luster. Color black, in thin splinters. blood-red. Streak cinnamon-brown. H. = 5—6. G. = 3.19—3.23.

Fused with sodium carbonate, gives green bead of manganese. Insoluble in hydrochloric acid.

San Benito County: Black crystals of neptunite occur with benitoite in a natrolite vein in schist about 4 miles south of New Idria near the headwaters of the San Benito River, and were first described by Louderback (07), (09). The crystals show the forms: (001), (100), (110), (111), ($\bar{1}11$), ($\bar{1}12$), ($\bar{2}11$), ($\bar{2}21$), and ($\bar{3}11$). An analysis was made by Blasdale:

SiO_2	TiO_2	FeO	MnO	CaO	MgO	K_2O	Na_2O
53.44	17.18	11.23	1.78	0.25	1.82	5.39	9.14 = 100.23%

The mineral was later analyzed by W. M. Bradley (09).

SiO_2	TiO_2	FeO	MnO	CaO	MgO	K_2O	Na_2O
52.91	17.77	11.54	0.82	1.59	1.41	5.11	9.83 = 100.98%
52.83	17.89	11.83	0.88	1.53	1.48	5.06	9.28 = 100.78%

Further notes on neptunite: by Arnold (08), Ford (09), and Schaller (11).

JOAQUINITE

Sodium, barium, and iron titano-silicate, $NaBa(Ti,Fe)_3Si_4O_{15}$.

Orthorhombic. In minute crystals. Honey-yellow to brown. H. = 5½-6. G. = 3.89.

Fuses with intumescence to brown glass. Insoluble.

San Benito County: Joaquinite was discovered in minute crystals showing the forms (001), (111), and (100) with benitoite and neptunite in natrolite veins near the headwaters of the San Benito River, and named by Louderback (09). The formula was assigned by Palache and Foshag (32) from an analysis by Foshag.

SiO_2	TiO_2	FeO	BaO	MgO	Na_2O
36.4	30.5	3.5	24.7	0.3	4.6

XONOTLITE

Hydrous calcium silicate, $5CaSiO_3.H_2O$.

Orthorhombic? Compact fibrous. Cleavage (010) perfect. Vitreous to silky luster. Color snow-white, pink. H. = 6½. G. = 2.7.

Fuses easily to a glassy globule. Easily soluble in hydrochloric acid with the separation of flaky silica. Yields water at a high temperature.

Xonotlite closely resembles pectolite in structure.

San Francisco County: Xonotlite occurred with brucite in veins in serpentine exposed by excavations of the Western Pacific Railroad on Army Street, San Francisco.

Santa Barbara County: A mineral specimen collected years ago near Santa Ynez, labeled wollastonite, was found by Larsen (17) to differ optically from that mineral, and on the supposition that it was a new mineral, he proposed the name *eakleite* for it. Larsen (23) later showed this material to be xonotlite. Analysis of the mineral by Eakle gave:

SiO_2	Fe_2O_3	CaO	MgO	$Na_2O.K_2O$	H_2O
50.17	1.04	45.45	tr.	none	3.18 = 99.84%

INESITE

Hydrous manganese and calcium silicate, $H_2(Mn,Ca)_6Si_6O_{19}.3H_2O$.

Triclinic. Prismatic crystals, sometimes fibrous radiating or spherulitic. Cleavage perfect brachypinacoidal. Vitreous luster. Color rose-red. H. ≐ 6. G. = 3.03.

Fusible. Decomposed by hydrochloric acid.

Inesite is a common associate of psilomelane in several of the mines of the State.

Alameda County: Rose-red veins of inesite with bementite intersect the rhodochrosite, at the Newhall or Bailey mine, 10 miles southeast of Livermore, on the Arroyo Mocho.

Mendocino County: Inesite veins with bementite and neotocite occurred in the rhodochrosite claim at Impassable Rock, Mount Sanhedrin, about 8 miles from Hearst.

San Joaquin County: Inesite with bementite was common at the old Ladd mine.

Stanislaus County: Gray rhodochrosite of the Cummings lease or Winship properties is intersected by veinlets of rose-red inesite with bementite. Forms observed by Foshag and Eakle on the inesite crystals are: $(1\bar{1}0)$, (100), (010), and (001), Eakle (23).

FOSHAGITE

Hydrous calcium silicate, $H_2Ca_5(SiO_4)_3.2H_2O$.

Orthorhombic. Compact, fibrous. Silky luster. Color snow-white. H. = 3. G. = 2.36.

Infusible. Easily soluble in hydrochloric acid with gelatinization.

Riverside County: Foshagite occurs in fibrous veins with thaumasite and blue calcite in idocrase in the Wet Weather quarry at Crestmore. It was named, analyzed, and described as a new mineral by Eakle (25). Analysis:

SiO_2	Fe_2O_3	CaO	MgO	CO_2	H_2O
33.92	0.83.	53.48	tr.	1.83	10.19 = 100.25%

RIVERSIDEITE

Hydrous calcium silicate, $2CaSiO_3.H_2O$.

Orthorhombic? Fibrous. Silky luster. Color white. H. = 3. G. = 2.64.

Fuses easily to a white glass. Easily soluble with separation of flocculent silica.

Riversideite is formed by hydrothermal metamorphism of limestone.

Riverside County: Riversideite was discovered with idocrase at the Crestmore limestone quarry. It was named for the county; analyzed and described by Eakle (17). Analysis:

SiO_2	CaO	P_2O_5	SO_3	H_2O
41.26	44.58	3.84	1.84	8.11 = 99.63%

JURUPAITE

Hydrous calcium and magnesium silicate, $H_2(Ca,Mg)_2Si_2O_7$.

Monoclinic. Fibrous, radiating. Snow-white color. H. = 1 — 4. G. = 2.75.

Fuses easily to a clear white glass. Easily soluble without gelatinization.

Jurupaite is a mineral formed by hydrothermal metamorphism of limestone.

Riverside County: Jurupaite occurs with bluish calcite and grossularite at the Crestmore limestone quarry, and was named, analyzed, and described as a new mineral by Eakle (21).

SiO_2	CaO	MgO	H_2O
48.87	38.66	4.19	7.89 = 99.61%

CRESTMOREITE

Hydrous calcium silicate, $2CaO.2SiO_2.3H_2O$.

Monoclinic. Fibrous, compact. Vitreous to dull luster. Color snow-white. H. = 3. G. = 2.22.

Fuses quietly and easily to a slightly vesicular glass. Easily soluble with separation of flocculent silica. Gives reaction for sulphate, phosphate, and carbonate.

Crestmoreite is formed by hydrothermal metamorphism of limestone.

Riverside County: Crestmoreite was discovered at the Crestmore limestone quarry. It was formed as an alteration of wilkeite, and also as a direct crystallization. It was named for the locality, and described and analyzed by Eakle (17). Analysis:

SiO_2	CaO	P_2O_5	SO_3	CO_2	Ign.
36.12	42.71	2.38	2.42	1.16	14.98 = 99.77%
38.30	41.20	3.50	1.25	---	15.17 = 99.42%
34.42	43.54	3.50	2.24	---	16.24 = 99.94%

CHRYSOCOLLA

Hydrous copper silicate, $CuSiO_3.2H_2O$.

Cryptocrystalline. Opal-like, earthy, incrustations. Vitreous to dull luster. Color bluish-green, turquois-blue. Streak white. H. = 2½ — 3. G. = 2 — 2.24.

Infusible, but soluble in nitric acid without forming a jelly. A blue solution is obtained by adding ammonia to the nitric acid solution. Can be reduced to metallic copper by fusing on charcoal with sodium carbonate. Darkens and gives water in a closed tube.

Small amounts of chrysocolla occur in most of the copper districts of the State, as an oxidation product of copper minerals, usually as incrustations.

Amador County: Chrysocolla is common at Volcano.

Calaveras County: It is common at Campo Seco and at Copperopolis.

Fresno County: It was found at the Ne Plus Ultra mine. It occurred as an alteration of copper minerals at the Gordon Fresno Copper mine and at the Red Streak mine, Big Dry Creek.

Inyo County: Chrysocolla was common at the Cerro Gordo mines. It occurred as a pseudomorph after limonite at the Aries mine, and as an alteration of chalcopyrite in the Gold Belt of the Panamint Range. It occurred with brochantite near the headwaters of Cottonwood Creek, Ball (07). It was found with garnet at the Green Monster mine, 1½ miles north of Citrus. It occurs as an alteration of chalcopyrite in garnet rock in Mazourka Canyon. It was found with the scheelite of Deep Canyon, west of Bishop. It occurred with cerargyrite at the Bonanza King mine, Sherman district; in the Ubehebe Mountains. It was found with azurite, cuprite, malachite, and melaconite in the mines of the Greenwater district, Black Mountains. Pseudo-

morphs of chrysocolla after calcite have been described from the Reward gold mine by Rogers (10a).

Los Angeles County: Chrysocolla was reported from the old Kelsey mine near San Gabriel Canyon, Storms (93).

Mendocino County: It occurred in the Red Mountain mining district.

Modoc County: It was found with malachite and cuprite near Fort Bidwell.

Mono County: Chrysocolla was common in the Lundy district. It occurred with partzite at the Diana mine, Blind Spring Hill district.

Nevada County: It was common with the copper ores of Meadow Lake and at Spenceville.

Plumas County: Chrysocolla occurred in banded masses with malachite in Lights Canyon, and in the Mohawk Valley. Chrysocolla and malachite were found at the Engels mine.

Riverside County: It has been found in the mines of the Chuckawalla Mountains. Good specimens of chrysocolla have come from the Mountain King mine.

San Benito County: Small amounts of it occur with chalcocite in natrolite near the headwaters of the San Benito River, Louderback (09).

San Bernardino County: It was common in the Calico and Bismark districts, Lindgren (87). Massive chrysocolla occurred at the Copper World mine, Clark Mountain.

San Diego County: Chrysocolla was common in the Julian and Banner districts.

Santa Clara County: It was found with malachite near Fifteen Mile House. Rogers (10a) has described pseudomorphs of chrysocolla after cuprite from the Santa Margarita mine, near New Almaden.

Siskiyou County: It occurred at the Blue Ledge mine.

SEARLESITE

Hydrous sodium borosilicate, $NaB(SiO_3)_2.H_2O$.

Monoclinic. Prismatic. In radiate-fibrous spherulites. Cleavage (100) perfect. Color white. Very soft. G. = about 2.45.

Fuses easily to a clear glass. Easily soluble in hydrochloric acid and somewhat soluble in water.

San Bernardino County: Searlesite occurred as crusts of white spherulites at Searles Lake. It was described and named by Larsen and Hicks (14) with analysis by Hicks:

SiO_2	B_2O_3	Na_2O	K_2O	MgO	FeO	Al_2O_3	H_2O
56.41	16.26	12.78	1.00	1.82	1.89	0.37	9.47

BAVENITE

Hydrous beryllium, aluminum, and calcium silicate, $BeO.Al_2O_3.4CaO.9SiO_2.H_2O$.

Monoclinic. In fibrous-radiated groups of prismatic crystals. Cleavage (010). Colorless to white. H. = 5½. G. = 2.7.

San Diego County: Bavenite occurring as a pseudomorph after beryl at the Himalaya mine at Mesa Grande has been described by Schaller and Fairchild (32). Forms: (100), (010), (001), (110), (210), (101), (201) and (012). Analysis by Fairchild:

SiO_2	Al_2O_3	Fe_2O_3	CaO	BeO	H_2O
58.40	12.16	0.10	23.73	2.67	2.90 = 99.96%

BENITOITE

Barium titano-silicate, $BaTiSi_3O_9$.

Hexagonal; ditrigonal-bipyramidal. Trigonal pyramids with prisms. Vitreous luster. Colorless to deep-blue. Transparent. H. = 6½. G. = 3.64 — 3.67.

Fusible. Gives the green flame of barium. Soluble sufficiently to give the titanium reaction when the hydrochloric acid solution is boiled with tin.

San Benito County: Colorless and beautiful sapphire-blue crystals of this gem mineral were discovered in 1907 near the headwaters of the San Benito River, about 25 miles north of Coalinga, and named by Louderback (07), (09). They show the forms: (0001), $(10\bar{1}0)$, $(01\bar{1}0)$, $(10\bar{1}1)$, $(01\bar{1}1)$, $(11\bar{2}0)$, $(10\bar{1}2)$, $(22\bar{4}1)$, and are of trigonal habit. The crystals occur in a zone of narrow veins of natrolite in serpentine, and are associated with neptunite, chalcocite, chrysocolla, actinolite, joaquinite, crossite, albite, aegirite, calcite, aragonite, and psilomelane. Analyses of benitoite were made by W. C. Blasdale:

SiO_2	TiO_2	BaO
43.56	20.18	36.34 = 100.08%
43.79	20.00	36.31 = 100.10%

Additional notes on benitoite have been made by Baumhauer (09), Hlawatsch (09), Palache (09), and Rogers (08).

TOURMALINE

Aluminum borosilicate with various bases.

Hexagonal-rhombohedral; ditrigonal—pyramidal. In long prismatic crystals; divergent radiating groups. Brittle. Vitreous to resinous luster. Color black, brown, blue, green, rose-red, violet, colorless. Streak uncolored. H. = 7 — 7½. G. = 2.98 — 3.2.

Generally fusible to a blebby mass. Fused on platinum wire with a mixture of potassium bisulphate and fluorite, will give a momentary green flame. Insoluble in acids.

Black tourmaline is a very common mineral, and large areas of tourmaline-granites exist in the Sierra Nevada. The richly colored red and green tourmalines of San Diego County are the finest in the world, and have become widely known and used as gems. Tourmaline always

occurs in prismatic crystals, often bunched into radiating groups and usually much fractured. The common black tourmaline is characteristic of granites and quartz veins in granites. Brown tourmaline is found in crystalline limestone near contacts with intrusive igneous rock. Translucent pink or green tourmaline contains lithium and is found only in pegmatites. Pink tourmaline is often called *rubellite.*

Alpine County: Black tourmaline is common in Hope Valley.

Calaveras County: Black tourmaline occurs in quartz at Sheepranch.

El Dorado County: Black tourmaline occurs with orthoclase at Bucks Bar. Black tourmaline occurs at Emerald Bay, Lake Tahoe.

Fresno County: Black tourmaline is common in Fine Gold Gulch, at the Enterprise mine, and at Eber Flat. Black crystals of tourmaline with hornblende and quartz occur in Watts Valley. Black tourmaline occurs in the Sycamore district. Red and green tourmaline occurs in quartz on the White Divide, south of Mount Goddard. Green tourmaline with brown garnet occurs on Spanish Peak, W. W. Bradley (16a).

Inyo County: Black tourmaline occurs in the Lee district. Black crystals of tourmaline occur in a metamorphosed sandstone at Deep Canyon, west of Bishop. It is found as needles and reticulated masses of black, slender prisms in the Slate Range.

Kern County: Black tourmaline is found in the rocks of the Tehachapi Mountains. Black tourmaline with scheelite occurs in a calcite vein cutting schist, a few miles west of Randsburg. A large vein of quartz and feldspar containing black tourmaline occurs near Woody.

Lassen County: Specimens of black tourmaline have come from near Susanville.

Madera County: Black tourmaline occurs in the rocks near Raymond.

Modoc County: Black tourmaline crystals occur in quartz near Cedarville.

Mono County: Radiating masses of black tourmaline occur near a contact mass of magnetite, which carries greenockite, near Topaz.

Nevada County: Dark-brown tourmaline found 2 miles northwest of Colfax was analyzed by Melville (92).

SiO_2	Al_2O_3	$Fe_2O_3.FeO$	CaO	MgO	K_2O	Na_2O	B_2O_3
36.40	33.64	3.13	1.51	10.01	0.12	2.49	a8.74

Ign.	F	O = F	
3.53	0.74 = 100.31	— 0.31 = 100%	G. = 3.065

a = By difference.

Orange County: Black tourmaline is found at the Santa Ana tin mine, Santa Ana Mountains.

Placer County: Black tourmaline occurs at Soda Springs; with quartz near Blue Canyon and at the Excelsior mine, near Cisco. Black tourmaline with white feldspar and glassy quartz occurs in granitic rock near Rocklin.

Plumas County: Black tourmaline occurs at Red Clover Creek. Black tourmaline in quartz occurs on Grizzly Range, and near Taylorsville. It occurs in the pegmatites at Engels.

Riverside County: Fine gem tourmaline occurs near Coahuila and in the San Jacinto Mountains. Black tourmaline in quartz occurs in the Santa Maria Mountains, 2 miles north of Blythe. Black tourmaline occurs in the pegmatite veins at Crestmore, Eakle (17). Black radiating prisms of tourmaline occur with axinite on Box Spring Mountain. It occurs in a pegmatite vein in the Pinacate district. Black tourmaline occurs with cassiterite in the Cajalco tin mine about 11 miles southwest of Riverside, West (28).

San Bernardino County: Black tourmaline occurs at Halleck.

San Diego County: A series of pegmatite veins consisting mainly of white albite with quartz and lepidolite cut through the diorite hills in the northwestern part of the county from Mesa Grande northward through Pala. These veins have been prolific in their yield of beautiful transparent tourmalines in many shades of rose-red and green. The first mention of the occurrence of rubellite and lepidolite in southern California was by W. P. Blake (82) who gave the locality as the Bernardino Range. The first material obtained was the lavender and lilac lepidolite containing radiating clusters of bright-red rubellite prisms, which form beautiful museum specimens and can be seen in most mineral collections. The gem varieties were found later, Fairbanks (93a), and since 1893 a number of mines have been located and many beautiful large crystals obtained. At present the best tourmalines come from Mesa Grande. Sterrett (04) gives the crystallography of tourmaline from Damoron's ranch, 4 miles northwest of Mesa Grande. Forms: $(02\bar{2}1)$, $(12\bar{3}0)$, $(14\bar{5}0)$, $(21\bar{3}1)$, $(12\bar{3}2)$, $(000\bar{1})$, $(01\bar{1}\bar{1})$, $(10\bar{1}\bar{2})$, $(11\bar{2}0)$, $(10\bar{1}0)$, $(01\bar{1}0)$, $(10\bar{1}\bar{1})$, and (0001). Black, pink, blue, violet, green, and colorless tourmaline occurs at Rincon in the Victor and other claims; some of the crystals have the forms: $(11\bar{2}0)$, $(10\bar{1}0)$, $(01\bar{1}0)$, $(12\bar{3}2)$, $(10\bar{1}\bar{1})$, $(000\bar{1})$, and $(01\bar{1}\bar{1})$, Rogers (10).

Analyses of the tourmaline of the county have been made by Schaller, Clarke (10), specific gravities from Schaller (12). 1. Pink from Mesa Grande; 2. Pale-green from Mesa Grande; 3. Pink from Pala, partly altered; 4. Pink from Pala, almost completely altered; 5. Black from Lost Valley; 6. Black from Ramona.

	1	2	3	4	5	6
SiO_2	37.57	36.72	36.98	37.05	35.96	35.21
Al_2O_3	42.18	41.27	43.69	44.25	33.28	36.07
Ti_2O_3	tr.	0.06	---	---	0.36	0.23
Fe_2O_3						
			---	---	11.04	11.11
FeO	0.19	1.13				
MnO	0.24	1.48	tr.	tr.	0.13	0.98
MgO	none	none	tr	0.10	3.48	0.19
CaO	1.20	0.87	0.25	0.22	0.42	0.25
Li_2O	1.92	1.76	1.28	1.27	none	tr.
Na_2O	2.05	2.23	2.02	1.06	2.16	1.92
K_2O	none	none	2.29	1.95	none	none
B_2O_3	10.65	10.60	a7.66	a2.46	10.61	10.43
$H_2O—$			1.16	0.83		
	3.38	3.33			3.31	3.51
H_2O+			4.67	10.81		
F	0.39	0.31	undet.	undet.	none	none
	99.77	99.76	100.00	100.00	100.75	99.90%
Less O	0.17	0.13				
	99.60	99.63				
G. =	3.04	3.04			3.16	3.22

a = By difference.

Bluish-green tourmaline is found in the Mountain Lily mine near Oak Grove. Fine blue and pink tourmaline occurs at the Peter Cabat mine, about 6 miles north of Warners Hot Springs. A deposit of green tourmaline occurs south of Banner. Good blue and green tourmaline occurs on the east side of Chihuahua Valley. Black tourmaline occurs with cassiterite on Aguanga Mountain.

San Luis Obispo County: Black tourmaline occurs in the rocks of the Santa Margarita Hills.

Siskiyou County: Black crystals of tourmaline in quartz occur near Etna Mills. Black, slender crystals of tourmaline in quartz with specular hematite occur at Westwood.

Trinity County: Small rosettes of black tourmaline occur at the Mountain Monarch prospect, Weaverville Quadrangle.

Tulare County: Black tourmaline occurs in Frazier Valley, Drum Valley, and at Mineral King. Black tourmaline crystals with feldspar and muscovite occur near Milo. Black tourmaline in quartz occurs near Dinuba.

Tuolumne County: Black tourmaline occurs near Crimea House, near Sonora and near Soulsbyville. It occurs as black prisms with quartz about 8 miles south of Sonora.

BERYL

Beryllium and aluminum silicate, $Be_3Al_2Si_6O_{18}$.

Hexagonal. Prismatic crystals. Brittle. Vitreous luster. Color green, blue, rose, yellow. Streak white. H. = $7\frac{1}{2}$ — 8. G. = 2.63 — 2.80.

Whitens and is very difficult to fuse, yielding an enamel. Insoluble in acid.

Beryl is found as crystals, sometimes attaining great size, in granite pegmatites.

Aquamarine is a pale-blue to pale-green beryl. *Emerald* is a transparent, green beryl. *Morganite* is pink.

Fresno County: Beryl was reported to be associated with the feldspar 5 miles northeast of Trimmer.

Inyo County: Blue crystals of beryl are reported to occur in quartz, in narrow pegmatite veins cutting granite 6 miles south-southeast of Lone Pine.

Riverside County: Fine yellow and green beryl was found at Coahuila and rose beryl occurred near Hemet. Green and blue beryl crystals about half an inch long have been found in a pegmatite dike about 200 yards west of the Jensen limestone quarry, near Crestmore.

San Diego County: Yellow, green, and blue crystals of beryl occur in the Palomar Mountains, 9 miles southeast of Pala. Rose, yellow, and green beryl crystals occur at Pala and Mesa Grande. Green crystals of beryl from Rincon have the forms: $(10\bar{1}0)$, (0001), $(10\bar{1}1)$, $(11\bar{2}0)$, $(11\bar{2}1)$, $(21\bar{3}0)$, $(11\bar{2}2)$, $(13.1.\overline{14}.1)$, while the rose crystals of beryl have the forms: $(10\bar{1}0)$, $(11\bar{2}1)$, $(10\bar{1}1)$, (0001), Eakle (07). Beryl was mentioned by Kunz (05), Schaller (04a), Rogers (10), and G. A. Waring (05a). Pink beryl occurs at the Katrina mine, Pala. Fine, large crystals of beryl have come from Aguanga Mountain. Golden and aquamarine beryl occurred at the Esmeralda mine. Fine crystals of beryl were found at the Surprise, A B C, Hercules, and Lookout mines, Ramona. Beryl from Mesa Grande has been analyzed by Ford (10).

SiO_2	Al_2O_3	BeO	Cs_2O	K_2O	Na_2O	Li_2O	Ign.
64.98	17.86	13.42	---	0.18	0.84	0.46	2.16 = 99.90%

Pink beryl from Oak Grove has been analyzed by Schaller, Clarke (15).

SiO_2	Al_2O_3	BeO	Cs_2O	K_2O	Na_2O	Li_2O	H_2O
62.95	17.79	11.40	1.60	---	2.53	0.99	2.49 = 99.75%
							G. = 2.753.

Tuolumne County: W. P. Blake (58) reported beryl from near Jamestown.

GEHLENITE

Calcium and aluminum silicate, $Ca_2Al_2SiO_7$.

Tetragonal. In short square prisms. Massive granular. Brittle. Resinous to vitreous luster. Color gray to brown. Streak white. H. = $5\frac{1}{2}$ — 6. G. = 2.9 — 3.07.

Practically infusible. Gelatinizes with hydrochloric acid.

Riverside County: Gehlenite occurs in granular masses intimately associated with merwinite and spurrite and with diopside and wollastonite at the Crestmore limestone quarry, Foshag (20).

Tulare County: Material from this county associated with andradite was described by Shannon (22) as the variety *velardeñite*, analysis:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	H_2O
27.88	25.52	1.59	0.43	4.18	40.80	0.34 = 100.80%

HEMIMORPHITE—Calamine

Zinc silicate, $H_2Zn_2SiO_5$.

Orthorhombic. Hemimorphic crystals. Drusy masses, earthy. Cleavage perfect prismatic. Brittle. Vitreous luster. Color white; sometimes bluish or brown. Streak white. H. = 4½ — 5. G. = 3.4 — 3.5.

Fuses with difficulty. Mixed with sodium carbonate and reduced on charcoal, gives yellow coating of zinc. Yields some water in a closed tube. Soluble with gelatinization.

Hemimorphite is found in the oxidized portion of veins carrying zinc, but its occurrence in California is limited.

Inyo County: Small amounts of hemimorphite have been found with willemite and smithsonite at the St. Ygnacio, Cerro Gordo, and Indiana mines, and in Surprise Canyon.

San Bernardino County: It was found with smithsonite at the Cuticura mine, near Daggett.

LAWSONITE

Calcium and aluminum silicate, $H_4CaAl_2Si_2O_{10}$

Orthorhombic. Prismatic and tabular crystals. Cleavage perfect basal and brachypinacoidal. Vitreous luster. Color pale-blue to white. H. = 7 — 8. G. = 3.09.

Swells and fuses to a frothy mass. Very slightly acted on by hydrochloric acid. Yields water in a closed tube.

Lawsonite was discovered in California as a new constituent of certain schists, and has been found to be widespread in the metamorphic rocks of the Coast Ranges.

Alameda County: Lawsonite occurring in seams in a boulder of glaucophane schist near the head of the Arroyo Mocho was analyzed by Small, Rogers (15a).

SiO_2	Al_2O_3	CaO	MnO	MgO	TiO_2	CO_2	H_2O
38.10	32.21	17.74	nil	nil	nil	1.12*	10.85 = 100.02%

* from contaminating calcite.

Contra Costa County: It was found as a constituent of a chlorite boulder on the side of a hill north of Berkeley and analyzed by Eakle (07).

SiO_2	$Al_2O_3Fe_2O_3$	CaO	H_2O
38.43	33.39	16.85	9.83 = 98.50%

Los Angeles County: It occurred in schist near the summit of San Pedro Hill and on Santa Catalina Island, Woodford (24).

Marin County: Lawsonite was discovered as a new mineral in the schists of the Tiburon Peninsula half a mile east of Reed Station. It

was described and named by Ransome (95). Forms: (011), (110), (041), and (001). Additional forms by Schaller and Hillebrand (04): (221) and (331).

Analyses: 1. Ransome and Palache, Ransome (95); 2. Schaller and Hillebrand (04).

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	Ign.	Total
1.	38.10	---	28.88	0.85	---	---	18.26	0.23	---	0.65	11.42	98.39%
	37.32	---	35.14		---	---	17.83	---	---	---	11.21	101.50%
2.	38.45	0.38	31.35	0.86	0.10	tr.	17.52	0.17	0.23	0.06	11.21	100.33%

Mendocino County: The most northerly occurrences of lawsonite so far noted in this State are in glaucophane schist on Burger Creek 2 miles northwest of Dos Rios and near the headwaters of Jumpoff Creek.

San Luis Obispo County: Platy crystals of lawsonite in masses of green chlorite occur about 4 miles east of San Luis Obispo. It was found in glaucophane schist near Cayucos, J. P. Smith (06).

Santa Clara County: Lawsonite was mentioned by J. P. Smith (06) as a constituent of glaucophane schist on Oak Ridge 5 miles east of the Calaveras Valley; at the San Juan mine, Oak Hill, near San Jose; also 1 mile south of the mouth of Coyote Canyon.

Sonoma County: It occurs with pumpellyite as veins in glaucophane schist at Mill Creek; Irving, Vonsen and Gonyer (32).

OLIVINE GROUP

OLIVINE—Chrysolite—Peridot

Magnesium and iron silicate, $(Mg,Fe)_2SiO_4$.

Orthorhombic. Crystals flattened, elongated. Massive, compact, or granular; in embedded grains. Cleavage (010) distinct. Brittle. Vitreous luster. Color olive-green, grayish-green. Streak uncolored. H. = 6½ — 7. G. = 3.27 — 3.37.

Usually infusible, but whitens when heated and may become magnetic if much iron is present. Soluble in hydrochloric acid yielding gelatinous silica upon evaporation.

Olivine is a rock-forming mineral which is practically limited to very basic eruptive rocks like diabase, basalt, andesite, gabbro, and peridotite. It occurs occasionally in clear green crystals large enough to cut into gems.

Butte County: Olivine is a constituent of diabase at Mooreville Ridge, Turner (94a). It was found in the concentrates at Oroville and Cherokee.

Del Norte County: Olivine occurs in the sands at Crescent City, Gilbert Creek, and Smith River.

Humboldt County: It was found in the beach sands at Gold Bluff, Orleans Bar, and Trinidad.

Los Angeles County: A small amount of olivine is found in the sand at Ocean Park.

Mendocino County: It occurs in the sand at Fort Bragg.

Modoc County: Olivine is a constituent of the basalt near Cedarville.

Nevada County: It occurs in the gabbro-serpentine series at Grass Valley, Lindgren (96).

Plumas County: Olivine is a constituent of plumasite at Spanish Peak, Lawson (03).

Riverside County: It occurs in the basalts of the Eagle Mountains.

San Bernardino County: Large bombs of granular olivine occur in the basaltic rocks of the Morongo district. Olivine bombs are common in the lavas along the State Highway, near Amboy.

San Diego County: It is a constituent of the gabbro at Dehesa, Lawson (04).

San Francisco County: It occurs in the serpentine of San Francisco, Lawson (95), Palache (94).

San Mateo County: It was found in the beach sands of the county.

Santa Clara County: Olivine occurs as dunite on the Miller and Lux ranch, southwest of Gilroy.

Santa Cruz County: Crystals of olivine occur in the sands at Aptos.

Siskiyou County: It was found in the sands at the Forks of the Salmon.

Trinity County: It is a common constituent of the basic rocks west of Trinity River, Weaverville Quadrangle.

Yuba County: It is a very prominent constituent of the concentrated sands at Marysville.

FAYALITE

Iron silicate, Fe_2SiO_4.

Orthorhombic. Mostly in small crystals. Cleavage (010) distinct. Vitreous luster. Color yellow, brown, black. H. = 6½. G. = 4.1.

Infusible. Soluble in hydrochloric acid; yields gelatinous silica on evaporation.

Inyo County: Small brown crystals of fayalite occur with cristobalite and orthoclase in spheroidal openings in obsidian near Coso Hot Springs, Rogers (22).

Siskiyou County: Fayalite occurs with cristobalite in lithophysae in spherulitic obsidian near Canyon Butte, in Sec. 13, T. 44 N., R. 4 E., M. D. M.

TEPHROITE

Manganese silicate, Mn_2SiO_4.

Orthorhombic. Usually massive. Brittle. Cleavage (010) distinct. Luster vitreous to greasy. Color grayish-red to smoky-gray. Streak pale-gray. H. = 5½ — 6. G. = 4.1.

Fuses to a black mass. Soluble in hydrochloric acid with gelatinization. Gives manganese and usually iron reactions.

San Diego County: Tephroite has been found with quartz and garnet in a quartzite boulder near the summit of San Onofre Mountain, Woodford (25).

Santa Clara County: Grayish-red tephroite in small residual masses occurred in the manganese boulder found near Alum Rock Park, 5 miles east of San Jose, Rogers (19a).

MONTICELLITE

Calcium and magnesium silicate, $CaMgSiO_4$.

Orthorhombic. In small crystals or grains. Cleavage (010) distinct. Brittle. Vitreous luster. Colorless to gray. Streak uncolored. H. = 5 — 5½. G. = 3.03 — 3.25.

Almost infusible, but soluble with gelatinization. Magnesium can be precipitated from a solution after all silica and calcium have been removed.

Monticellite is a rare mineral formed by contact metamorphism in magnesian limestone.

Riverside County: Monticellite is one of the many minerals occurring in the crystalline limestone at Crestmore. It was found massive and in isolated grains in the blue calcite, associated with xanthophyllite, Eakle (17).

SiO_2	FeO	CaO	MgO
37.26	3.35	34.26	24.74 = 99.61%

Moehlman and Gonyer (34) describe the occurrence of monticellite with garnet and diopside at Crestmore. Analysis by Gonyer:

SiO_2	FeO	MnO	MgO	CaO	H_2O	
37.46	3.98	0.52	22.78	35.20	0.15 = 100.09%	G. = 3.083.

San Bernardino County: It occurs in metamorphosed dolomite at the Dewey mine in the Clark Mountain district. Analysis by Schaller (35):

SiO_2	FeO	MgO	MnO	CaO	H_2O —	H_2O +	insol.
37.36	1.40	24.90	0.04	33.08	0.04	1.24	2.55 = 100.61%

MERWINITE

Calcium and magnesium silicate, $Ca_3Mg(SiO_4)_2$.

Monoclinic. In grains showing polysynthetic twinning. Compact granular masses. Cleavage (010). Greasy to vitreous luster. Colorless to pale-greenish. H. = 6. G. = 3.15.

Riverside County: Merwinite occurs as granular masses associated with gehlenite, spurrite, and wollastonite in the limestone quar-

ries at Crestmore. It was described and named by Larsen and Foshag (21). Analysis by Foshag:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	FeO	H_2O at 110°	H_2O Ign.
35.50	0.66	none	49.96	11.62	1.22	0.12	0.94 = 100.02%

It alters to thaumasite.

WILLEMITE

Zinc orthosilicate, Zn_2SiO_4.

Hexagonal-rhombohedral. Crystals usually prismatic. Also massive and granular. Cleavage basal. Brittle. Vitreous luster. Color white, light-green, apple-green, flesh-red. Streak uncolored. H. = 5½. G. = 3.89 — 4.18.

Fuses to a white enamel. On charcoal a zinc oxide coating is obtained, yellow while hot and white when cold, which turns yellowish-green when heated with cobalt nitrate. Soluble in hydrochloric acid, yielding gelatinous silica.

Inyo County: Willemite is found with hemimorphite and hydrozincite at the Ygnacio and Cerro Gordo mines.

CHONDRODITE

Magnesium fluosilicate, $2Mg_2SiO_4.Mg(F,OH)_2$.

Monoclinic. Usually in grains. Vitreous luster. Color yellow to brown. H. = 6 — 6½. G. = 3.1 — 3.2.

Infusible. Soluble with gelatinization.

Riverside County: Some of the crystalline limestone at Crestmore shows evidence of the former presence of granular chondrodite. It occurs in the limestone of the Jensen property about 3 miles west of Crestmore. It was reported to occur in the limestone at Colton, Eakle (17). It was observed in the city quarry at Riverside.

GARNET GROUP

Isometric. Rhombic dodechedrons and trapezohedrons are common. Also compact to granular massive. Vitreous luster. Color generally some shade of red; also yellow, brown, green, black, and white. Streak white. H. = 6½ — 7½. G. = 3.15 — 4.3.

Most garnets are fusible at about 3 to a brownish glass, but are insoluble. The iron garnets, almandite and andradite, become magnetic when fused and are slightly soluble, yielding a small amount of gelatinous silica. Uvarovite is infusible, but yields a chromium bead with borax. Spessartite yields a manganese bead with borax. The bases of most garnets can best be determined by wet methods, that is: precipitation of each from solution by reagents.

Garnet is one of the common minerals of the State and probably all of the known varieties occur here. Garnet is generally a product of metamorphism and is common in metamorphic rocks such as gneiss, schist, quartzite, and crystalline limestone. As a contact mineral formed by the intrusion of igneous rock into limestone and other rock, it is often found in fine large crystals. It is a common constituent of beach sands and of the concentrates of mining districts.

Grossularite, essonite, hyacinth. Calcium-aluminum garnet, $Ca_3Al_2Si_3O_{12}$. It is common as a contact mineral in crystalline limestone. It is generally a light shade of red or green, sometimes almost white, and when clear forms a valued gem. G. = 3.53.

Pyrope. Magnesium-aluminum garnet. $Mg_3Al_2Si_3O_{12}$. It occurs usually in serpentine and peridotite. Deep blood-red color. G.=3.51.

Almandite. Iron-aluminum garnet, $Fe_3Al_2Si_3O_{12}$. It is a common garnet of gneisses and schists. Color brownish-red and sometimes of gem value. G=4.25.

Andradite. Calcium-iron garnet, $Ca_3Fe_2Si_3O_{12}$. It is a common garnet of gneisses and schists. It is rarely clear enough for gems. Color yellow, green, brown, to black. *Topazolite* is a calcium-iron garnet having the color and transparency of topaz. *Aplome* is a manganiferous variety of andradite. G.=3.75.

Spessartite. Manganese-aluminum garnet, $Mn_3Al_2Si_3O_{12}$. It occurs usually in pegmatite veins. Dark-red color. G.=4.18.

Uvarovite. Calcium-chromium garnet, $Ca_3Cr_2Si_3O_{12}$. It is generally found as crystals coating massive chromite. Color emerald-green. G=3.41—3.52.

Alpine County: The old Uncle Billy Rogers copper claim in Hope Valley was located in garnet rock. W. P. Blake (66) reported fine green grossularite from this valley.

Butte County: Red and brown garnet was common in the sands of the gold washings at Cherokee, Silliman (73).

Calaveras County: Garnet occurs in the gravels of San Andreas. Good crystals of andradite occur in schist at the Shenandoah mine. Andradite is found with idocrase and epidote at Garnet Hill, just above the confluence of Moore Creek and the Mokelumne River, Melhase (35a).

Del Norte County: It is common in the sands at Crescent City, Gilbert Creek and Smith River.

El Dorado County: Large crystals of grossularite have been found at the old Cosumnes copper mine. Good crystals of garnet occured 9 miles southeast of Placerville. At the Lilyoma mine, Pilot Hill, crystals of garnet occurred with chalcopyrite, galena, calcite, and quartz. Garnet occurs with quartz and epidote at Grass Lake, near Glen Alpine. Garnet occurred at the Fairmount mine, 3 miles from Pilot Hill, in large blocks and masses 2 or more feet thick, W. P. Blake (66). Pure white grossularite with idocrase has been described by Pabst (36) from veins in serpentine along Traverse Creek about 2½ miles south-southeast of Georgetown. Crystals show the forms (110), (211), (321), and (332). Analysis by Herdsman:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	H_2O—
39.30	nil	21.93	0.80	0.13	0.28	nil	tr.	37.10	nil

H_2O+	CO_2	Ni		
0.30	nil	nil	= 99.84%	G. =3.506

Fresno County: Garnet occurs at Grub Gulch and Fort Miller. The limestone near Trimmer contains much garnet. Brown garnet is associated with green tourmaline on Spanish Peak in a ledge of white quartz. It was found in crystals near Dunlap. It was found near Spanish Mountain. White opaque garnet occurs in calcite with green californite at San Ramon on the south side of Watts Valley. It was found with galena and chalcopyrite at the Fresno Chief mine. White garnet occurring with californite 35 miles east of Selma has been analyzed by Steiger, Clarke and Steiger (05).

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	H_2O at 105°	H_2O ab. 105°
38.59	22.24	0.45	0.36	0.10	0.64	35.97	0.31	0.80

TiO_2	CO_2	F		O=F	
none	0.39	0.17	=100.02	— 0.07	= 99.95%
					G. = 3.586

Humboldt County: It is common in the sands at Gold Bluff and Orleans. It was found in chlorite schist at Big Lagoon.

Imperial County: Opaque white grossularite is found with wollastonite near the highway a few miles west of El Centro, Melhase (35a).

Inyo County: Crystals and massive garnet are found in the Coso and Inyo Mountains. Fine large crystals of grossularite occurred with massive white datolite and greenish-brown idocrase at the San Carlos mine; the mineral was analyzed by J. L. Smith (74):

SiO_2	Al_2O_3	Fe_2O_3	MnO_2	CaO	MgO	
42.01	17.76	5.06	0.20	35.01	0.13 = 100.17%	G. = 3.59

It is common in limestone at a contact with aplite at the Green Monster mine. It occurred as a contact metamorphic mineral in limestone in Mazourka Canyon. Garnet is one of the principal gangue minerals at the scheelite deposits about 7 miles west of Bishop, Knopf (17).

Kern County: It occurs massive near Hot Springs between Havilah and Kernville, and on the summit between Walkers Basin and Havilah. Sand garnet is abundant at Soapstone Mountain. Large crystals of almandite occur in granite on a branch of Tunis Creek, about half a mile southwest of the Tejon ranch headquarters, Melhase (35a).

Lassen County: It was common at the Diamond mine.

Los Angeles County: It occurs in the sands at Mount Meadows.

Madera County: It is common in the Hildreth district, and at Mount Raymond. Fair crystals of almandite have been found on the divide 1 mile east of Island Pass. Grossularite is abundant in limestone on Shadow and Johnston creeks, and garnet rock occurs at Garnet Lake, Erwin (34).

Marin County: Almandite crystals are common in the schists of the Tiburon Peninsula, Pabst (31).

Mariposa County: Massive brown almandite occurs on Mount Hoffman.

Mendocino County: It is common in the sands at Fort Bragg. Uvarovite occurs coating chromite about 12 miles north of Willets.

Monterey County: It is common in the sands of the Los Burros district. Trautwinite, which was described as a new mineral by Goldsmith (73), from this county, appears from the analysis to be a mixture of uvarovite and chromite.

SiO_2	Cr_2O_3	Fe_2O_3	Al_2O_3	CaO	MgO	Ign.
21.78	38.39	13.29	0.81	18.58	7.88	0.11 = 100.84%

G. = 3.505

Pyrope garnet occurs in granitic rock on the Nacimiento River. Garnet is abundant in the beach sand at the mouth of the Sur River, Trask (23).

Nevada County: Garnet is found in the concentrates of the Rough and Ready district. It occurred with wollastonite at Grass Valley, Lindgren (96). Fine green crystals occurred coating the chromite at the Red Ledge mine, 2 miles southwest of Washington, associated with rhodochrome and kämmererite. Garnet occurs in metamorphosed limestone on the west side of Faucherie Lake.

Orange County: It is a constituent of the schists near Anaheim. Pale apple-green pebbles of grossularite were found near El Toro and analyzed by Steiger, Clarke (95).

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	Alk	P_2O_5	Ign.
37.54	tr.	22.84	0.79	0.26	36.66	0.44	0.13	tr.	1.74 = 100.40%

G. = 3.485

Placer County: Essonite is found at Deer Park, and on the American River near Towle. Uvarovite has been found on chromite near Towle. Uvarovite has been found on chromite near Auburn. Andradite with epidote, anthophyllite, augite, and chalcopyrite occurs in the magnetite deposit at Hotaling. Fine uvarovite crystals have been found on chromite, 7 miles southeast of Newcastle at the Farmer Swanton mine, with rhodochrome and kämmererite. Garnet is found in the metamorphic rocks near Cisco.

Plumas County: It is found in the sands at Nelson Point and at the Good Hope mine. Oily green grossularite occurs at the Good Hope mine. It is found with epidote and the copper sulphides at the Duncan

mine, Genesee district, at a contact of limestone and granodiorite. It occurs near Portola in quartz rock.

Riverside County: It occurs massive at the Santa Ana tin district. Hyacinth or essonite is found at Hemet. An abundance of grossularite and some andradite garnet occurs in the crystalline limestone at Crestmore, associated with idocrase, diopside, and wilkeite. An analysis of the grossularite by J. Buford Wright, Eakle (17) gave:

SiO_2	Al_2O_3	Fe_2O_3	FeO	CuO	CaO	MgO	Na_2O	H_2O	
35.52	21.11	3.95	0.60	0.70	36.06	0.78	0.20	1.23 = 100.15%	G. = 3.39

Essonite or hyacinth garnet occurs with tourmaline in fine crystals at Coahuila. It occurs near Mecca in considerable quantity. Good crystals of garnet have been found in a pegmatite near the Southern Pacific Silica quarry at Nuevo. Garnet occurs in the old Riverside city quarry, Melhase (35a).

San Benito County: Fine green crystals were found coating chromite and rhodochrome at New Idria, Brush (66).

San Bernardino County: It was found with epidote and calcite in the iron ores at Dale. Red garnet and green epidote occur in the Cajon Pass.

San Diego County: Fine crystals of transparent essonite garnet are found in the tourmaline districts of Mesa Grande, Pala, and Rincon; they have been cut into gems under the name 'hyacinth.' Essonite also occurs about 10 miles east of Jacumba Hot Springs with idocrase and quartz. Garnet is found in the Julian district and at Ballina. Fine-granular red garnet occurs at Rincon, Rogers (10). Essonite or hyacinth in good crystals has come from Hercules, Surprise, Lookout, and Prophet mines at Ramona. It occurs near San Vicente. Massive garnet occurs at the McFall mine, 7½ miles southeast of Ramona. Essonite is found near Banner. Garnet is found with idocrase and calcite at Boulevard. Almandite in mica schist occurs on the San Margarita ranch. Massive garnet has come from the Dos Cabezas district. Spessartite from the Katerina mine on Heriart Hill, near Pala, was analyzed by Schaller, Wells (37).

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	MnO
37.06	21.96	none	20.05	tr.	0.08	20.41 = 99.56%

Santa Barbara County: It is common in the sands at Point Sal.

Santa Clara County: Garnet is a constituent of the eclogites of Calaveras Valley, Murgoci (06). It was analyzed from the omphacite-eclogite of Coyote Creek by W. O. Clarke, J. P. Smith (06).

SiO_2	Al_2O_3	FeO	MgO	CaO	
38.69	19.10	26.81	5.07	10.64 = 100.31%	G. = 3.818

Shasta County: Uvarovite has been found on chromite on Shotgun Creek. Red garnet occurs on Round Mountain. Bands of garnet mixed with pyroxene occur on the McCloud River on a contact between diabase and carboniferous limestone. Yellow garnet occurs with epidote near Castella.

Siskiyou County: It was found in the sands at Cecilville and on the Klamath River. Uvarovite coats chromite at the Martin McKean mine, near Callahan. Massive white to pale-green garnet occurs with californite on Indian Creek, Melhase (35a).

Sonoma County: Large masses of garnet occur near Petaluma, W. P. Blake (66). Almandite garnets occur abundantly with glaucophane and actinolite in schists at Camp Meeker and near Healdsburg. Garnet collected by Louderback from glaucophane schist near the mouth of the Russian River was analyzed by Pabst (31).

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	H_2O-	H_2O+
38.26	nil	19.93	4.87	20.40	0.04	3.94	12.02	0.48	0.12 = 100.06%

G. = 3.821.

Trinity County: Emerald-green crystals of uvarovite occur on chromite near Carrville. Andradite occurs at Peanut. It was found in limestone with epidote at Red Mountain. Colorless grossularite occurs with epidote, titanite, and zircon in a soda granite-porphyry in the Iron Mountain district.

Tulare County: Essonite in good crystals occurs at Three Rivers. Topazolite was found at the Old Soldier mine, Drum Valley, 12 miles northeast of Visalia. Aplome was found near Visalia. It occurs with tremolite on the North Fork of Tule River. It was found with quartz and epidote on the Kaweah River, 25 miles northwest of Exeter. Large crystals of grossularite occur with diopside, quartz, and epidote in metamorphic rock on a hill between Drum Valley and Slickrock Canyon. Grossularite is abundant in the metamorphic rocks near Three Rivers.

Tuolumne County: Garnet occurs in schist on the Jarvis ranch and at Soulsbyville. It occurs with quartz east of Columbia.

Ventura County: It is abundant in sands in the Piru district. Garnets with the forms: (110) and (211) occur in the Piru Mountains.

Yuba County: Uvarovite is found at the Red Lodge mine, Melhase (35a).

PLAZOLITE

Hydrous calcium and aluminum silicate, $3CaO.Al_2O_3.2(SiO_2,CO_2).2H_2O$.

Isometric. In minute dodecahedrons. Brittle. Vitreous luster. Colorless to light-yellow. H. = 6½. G. = 3.129.

Fusible, and easily soluble in hydrochloric acid, with separation of silica without gelatinization. Gives water in a closed tube.

Riverside County: Plazolite occurred as minute crystals with idocrase in the limestone quarry at Crestmore. Only a few specimens were found. It was named, analyzed, and described by Foshag (20a):

	I	II	III
SiO_2	24.13	23.85	25.06
Al_2O_3	23.66	22.77	24.63
CaO	40.22	40.13	40.13
MgO	0.12	----	tr.
H_2O	12.21	9.39	9.04
CO_2		3.41	1.13
	100.34%	99.55%	99.99%

IDOCRASE—Vesuvianite

Calcium and aluminum silicate, $Ca_{10}Al_4(Mg,Fe)_2(OH)_4Si_9O_{34}$.

Tetragonal. Square prisms. Granular massive. Brittle. Vitreous luster. Color green to brown, purple. Colorless. Streak white. H. = 6 — 6½. G. = 3.35 — 3.45.

Fuses with intumescence to a greenish or brownish glass. Insoluble, but the fused beads are soluble with gelatinization when powdered.

Idocrase is characteristically formed in limestone near a contact with intrusive rocks. It is often associated with grossularite garnet.

Californite is a very compact, massive green idocrase, resembling jade, named by Kunz (03a). It occurs as streaks and nodules in serpentine.

Butte County: Good green californite occurs on the west side of the North Fork of Feather River near Pulga, Melhase (34). Rogers (12) mentions some water-worn pebbles of idocrase from the Feather River.

Calaveras County: Idocrase occurs with garnet and epidote on Garnet Hill at the confluence of Moore Creek and the Mokelumne River, Melhase (35a).

El Dorado County: Brown crystals of idocrase occurred in the Siegel lode near Georgetown, W. P. Blake (66). Veins of idocrase occur in serpentine along Traverse Creek about 2½ miles south southeast of Georgetown. Good crystals of many colors showing the forms (001), (110), (100), (120), (111), (331), (221), (112), (011), (021), (031), (045), (131), (132), (263), and (151), are found in cavities in the veins, Pabst (36). Analyses by Herdsman:

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	Cr_2O_3	FeO
Green crystals	36.60	tr.	19.75	0.80	0.18	1.64
White veins	37.70	tr.	19.30	0.85	nil	0.37
	MgO	MnO	CaO	H_2O —	H_2O +	F
Green crystals	2.58	nil	37.80	0.20	0.40	nil
White veins	2.45	nil	38.30	0.10	0.70	nil
	CO_2	Ni				
Green crystals	nil	nil	= 99.95%	G = 3.326.		
White veins	nil	nil	= 99.77%	G. = 3.322.		

Fresno County: Californite occurs on the east side of Watts Valley, about 32 miles east of Fresno. It also occurs with white grossu-

larite garnet about 35 miles east of Selma. Analyzed by Steiger, Clarke and Steiger (05).

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO
36.55	18.89	0.74	0.74	none	2.33	35.97

H_2O at 105°	H_2O ab. 105°	TiO_2	CO_2	F	O=F	
0.58	3.42	none	0.91	0.13 = 100.26	— 0.05 = 100.21%	G. = 3.359.

Melhase (35) has reported the occurrence of brownish needles of idocrase at the head of Avenal Creek.

Inyo County: Brownish-green crystals of idocrase were found with garnet and massive white datolite at the San Carlos mine. Analyzed by J. L. Smith (74).

SiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	K_2O	Ign.
36.56	17.04	5.93	0.18	1.07	35.94	0.51	2.00 = 99.23%

Idocrase occurs with garnet in the metamorphic rocks of Round Valley on the north side of the Tungsten Hills, 9 miles west of Bishop, Chapman (37). It occurs with essonite in the Coso mining district. Murphy (32) has reported the occurrence of idocrase with diopside and epidote in limestone about 5 miles east of Ballarat.

Kern County: Small yellow crystals of idocrase occur in white crystalline limestone in Jawbone Canyon. Idocrase is said to occur in limestone wtih garnet, wollastonite, and diopside about 3 miles south of Havilah.

Modoc County: It was reported with calcite from Willow Ranch.

Placer County: Small crystals of idocrase occur in the metamorphic rocks near Cisco.

Riverside County: Green and brown idocrase masses and crystals are common in the crystalline limestone at Crestmore, and were described by Eakle (17). Forms: (001), (010), (110), (100), (011), (111), (221), (331), (441), (121), (131), (132), (154), and (285). Analyzed by J. Buford Wright:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CuO	CaO	MgO
36.88	17.61	3.11	0.46	1.50	1.06	33.27	4.73

Na_2O	H_2O	
0.34	0.61 = 99.57%	G. = 3.36.

San Diego County: Brown idocrase has been reported to occur with essonite garnet about 10 miles east of Jacumba Hot Springs, Kunz (05). It occurs with garnet near Boulevard.

Siskiyou County: Californite outcrops for about 200 feet along the South Fork of Indian Creek, 12 miles from Happy Camp; it was analyzed by Steiger, Kunz (03a):

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO
35.86	0.10	18.35	1.67	0.39	0.05	5.43	33.51

H_2O at 100°	H_2O ab. 100°	P_2O_5	CO_2	F	
0.29	4.18	0.02	---	--- = 99.85%	G. = 3.286.

This is the original californite locality. Californite was also found near Hawkinsville, and on the east shore of Miller Lake.

Tulare County: Red idocrase occurs in the Kaweah quarries 2 miles northeast of Lemon Cove on the south side of the Kaweah River. Large crystals of idocrase are found with diopside, grossularite, and wollastonite in the SW¼ Sec. 25, T. 17 S., R. 28 E., M. D. M., a quarter of a mile east of Three Rivers. Californite is found at the chrysoprase locality east of Porterville.

EPIDOTE GROUP

ZOISITE

Basic calcium and aluminum silicate, $HCa_2Al_3Si_3O_{13}$.

Orthorhombic. Prismatic crystals. Massive; columnar to compact. Cleavage perfect brachypinacoidal. Brittle. Vitreous luster. Color grayish-white, greenish-gray, rose-red. Streak uncolored. H. = 6 — 6½. G. = 3.25 — 3.37.

Fuses rather easily with some intumescence to a light-colored slaggy mass, which, if pulverized and boiled in hydrochloric acid, will yield gelatinous silica. A small amount of moisture can be obtained in a closed tube by intense heating.

Zoisite is often developed by the metamorphism of gabbros and diorites.

Thulite is a pink variety containing a small amount of manganese.

Saussurite is a mixture of zoisite, calcite, and plagioclase feldspar formed in gabbros and plutonic rocks by alteration.

Inyo County: Thulite occurs in large irregular patches in boulders on the east side of Saline Valley near the south end.

Kern County: Zoisite crystals up to 1 inch in diameter occur in schist about 1 mile south of Randsburg, Hulin (25).

Lake County: Zoisite is mentioned by Becker (88) as common in the metamorphic rocks at Sulphur Bank, and in the Coast Range. Analyzed from Sulphur Bank.

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	NiO	MnO	CaO
39.80	tr.	22.72	4.85	1.49	---	0.26	17.55
39.19	1.17	22.76	6.49	1.78	tr.	0.09	22.02

MgO	Na_2O	K_2O	H_2O	P_2O_5	
3.89	4.09	0.12	5.25	---	= 100.02%
1.64	3.38	0.58	1.12	tr.	= 100.22%

Plumas County: It was found in the Diadem lode, Meadow Valley, Turner (96).

Riverside County: Saussurite is common in the igneous rocks of the Eagle Mountains.

San Diego County: Zoisite occurs with actinolite in boulders of saussurite gabbro in the San Onofre breccia, Woodford (25).

Santa Clara County: It was mentioned by Murgoci (06) in the eclogite of Oak Ridge.

Shasta County: Saussurite from a gabbro on the Sacramento River road, 37 miles north of Pit River Ferry, was analyzed by Clarke, Clarke and Chatard (84):

SiO_2	Al_2O_3	FeO	CaO	MgO	Na_2O	H_2O		
42.79	29.43	3.65	18.13	1.40	2.51	2.42	= 100.33%	G. = 3.148

Sonoma County: Zoisite was found in quartzite at Pine Flat, Murgoci (06). It also occurs near Healdsburg.

Tulare County: Large masses of zoisite occur in a metamorphosed gabbro west and south of Rocky Hill, near Exeter.

EPIDOTE

Basic calcium, aluminum and iron silicate, $HCa_2(Al,Fe)_3Si_3O_{13}$.

Monoclinic. Crystals usually prismatic. Massive, fibrous, earthy. Cleavage perfect basal. Brittle. Vitreous luster. Color pistachio-green, dark-green, dark-brown, yellow. H. = 6 — 7. G. = 3.25 — 3.5.

Similar to zoisite in its reactions, but fuses to a black slag.

Clinozoisite is crystallographically similar to epidote, but contains little or no iron.

Epidote is a very common mineral in the State, especially as a secondary mineral in crystalline rocks. It is often found in aggregates of large crystals and columnar masses in veins with quartz and feldspar.

Alpine County: Epidote occurs in the hills near Loope.

Butte County: It was mentioned by Silliman (73) as a constituent of the gold washings at Cherokee.

Calaveras County: It was found with garnet, quartz, and idocrase at Garnet Hill, just above the confluence of Moore Creek and the Mokelumne River, Melhase (35a). Large crystals of epidote were found at Bald Point on the Mokelumne River; at Mokelumne Hill; and at Copperopolis. It was found with quartz 7 miles north of Angels Camp.

Colusa County: Green epidote is associated with hematite in a deposit 4 miles south of Lodoga.

Contra Costa County: It was found in the rocks on Mount Diablo, and in the Diablo Range.

El Dorado County: Fine large crystals of epidote, coated with axinite, occurred in a coarse vein with orthoclase, bornite, and molybdenite at the old Cosumnes copper mine. Minute prisms of epidote

in quartz occurred at Placerville. Granular aggregates of epidote occur in the schists at Mount Tallac and near Grass Lake.

Fresno County: It is common on Grub Gulch. It occurs as a contact mineral with quartz and garnet near Trimmer.

Humboldt County: Large prisms of epidote with calcite occur in schists on the west side of Horse Mountain.

Kern County: Epidote was found with scheelite at the Cadillac claims in the Greenhorn mining district.

Lassen County: It occurs with native copper at the Lummis mine.

Los Angeles County: It was found with bitumen and orthoclase at White Point, and with labradorite near San Pedro. It is disseminated through crystalline limestone in Pacoima Canyon, 3½ miles from San Fernando.

Madera County: Epidote is widespread in the Ritter Range. It is the most abundant silicate mineral in the metamorphosed limestone of Shadow and Johnson Creeks, Erwin (34). It occurred with quartz, hematite, and magnetite in the Hildreth mining district. Specimens of epidote have come from Coarse Gold.

Marin County: Epidote occurs with lawsonite near Reed Station, Ransome (95).

Mariposa County: Massive epidote occurs at Hornitos. It was found near Coulterville and at Yosemite Cliff. It occurs on the south side of Mount Hoffman.

Mono County: Massive epidote occurs at Epidote Peak at the head of the East Fork of Green Creek. It occurs in rock near Mono Lake.

Nevada County: It was found at Meadow Lake, Lindgren (93), and at Grass Valley. It occurred with quartz and calcite at the Oustomah mine.

Orange County: A partial analysis of epidote from the San Onofre breccia near San Juan Capistrano Point has been reported by Woodford (25):

SiO_2	Al_2O_3	Fe_2O_3	CaO
38.45	25.90	12.07	22.08 = 98.50%

Plumas County: Epidote was found with garnet and quartz on Mount Herbert. It occurs with garnet at a contact of limestone and granodiorite at the Cosmopolitan and Duncan mines in the Genesee district. It occurs with bornite and chalcopyrite at Engels.

Riverside County: Deep-green epidote occurs in the calcite, and long prismatic epidote crystals, altered brown, occur in the pegmatite

at Crestmore, Eakle (17). Epidote was found with specular hematite in the Monte Negro mining district, Storms (93). It occurs in gneiss on the Eagle Mountains. Epidote crystals over half a foot in length have been found in quartz near Alessandro. Epidote occurs with axinite and prehnite in the city quarry in Fairmont Park, Riverside.

San Bernardino County: It occurs coarsely crystalline with calcite at a contact of granodiorite and limestone in the Morongo district. It occurs with specular hematite 17 miles northwest of Needles. It was found with garnet, magnetite and hematite in the iron-ore deposit near Dale. It occurs in boulders in the lower part of Badger Canyon about 5 miles north of San Bernardino.

San Diego County: Epidote occurs as a secondary mineral with black tourmaline at Rincon, Rogers (10). Clear, transparent epidote crystals, of gem quality, occur at the McFall mine, 7½ miles southeast of Ramona.

San Luis Obispo County: It occurs with quartz, pyrite, and calcite near La Panza.

Santa Clara County: Epidote occurs in the eclogite of Calaveras Valley, Murgoci (06). Clinozoisite also occurs as a constituent of the eclogites of Calaveras Valley.

Shasta County: Epidote from this county was analyzed by Schaller, Clarke (15):

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O
38.22	25.12	8.75	1.25	0.19	tr.	22.77	0.11	0.06

H_2O at 105°	H_2O Ab. 105°	TiO_2	
0.52	3.04	0.33	=100.36%

Siskiyou County: It was found with dark-brown garnet and quartz on the South Fork of Coffee Creek. It occurs in schist near Seiad. Crystals of epidote occur in the ore of the King Solomon mine.

Sonoma County: Epidote occurs in glaucophane schist near Healdsburg.

Trinity County: Green epidote associated with colorless garnet, titanite, and zircon, occurs in a soda granite-porphyry in the Iron Mountain district, Weaverville Quadrangle. It was found with calcite at Douglas City. It occurs as a contact mineral with garnet in the limestone at Red Mountain.

Tulare County: It is common in the Mineral King district, Goodyear (88). Large divergent-columnar masses of epidote occur at Eber Flat and at Three Rivers. Epidote is also common in Frazier Valley. It occurs with quartz and garnet on Crowley Mountain, near Dunn

Valley. Specimens have come from near Lindsay. Massive epidote was found with quartz and garnet on a hill between Drum Valley and Slickrock Canyon, and on the west side of the Valley of Sheep Creek.

PIEDMONTITE

Basic calcium, aluminum, manganese, and iron silicate, $HCa_2(Al,Mn,Fe)_3Si_3O_{13}$.

Monoclinic. Prismatic crystals. Cleavage (001) good. Vitreous luster. Color reddish-brown and reddish-black. Streak reddish. H. = 6½. G. = 3.4.

Fuses easily with intumescence to a black glass. Gives a violet bead of manganese with borax. Insoluble in acid.

Kern County: Piedmontite has been identified in sediments penetrated by drill holes in the Lazard area, west of Lost Hills, Reed and Bailey (27).

Los Angeles County: Piedmontite has been found in quartz sericite schist near the junction of Boquet and Texas Canyons, Simonson (35), and in a ravine entering the Prairie Fork of San Gabriel River from the south, about 3 miles above the mouth of the fork.

Madera County: Piedmontite occurs in minute needles in a sericite schist 100 yards below the outlet of Shadow Lake, and as small tablets in a metamorphosed extrusive rock at the summit of the east end of Volcanic Ridge, Mayo (32). Short (33) has published an analysis of the piedmontite from Shadow Lake by T. Kameda:

SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	H_2O	TiO_2	Mn_2O_3
35.26	23.50	4.65	0.21	22.73	1.37	0.12	12.13 = 99.97%

G. = 3.46

Orange County: Woodford (25) has reported the occurrence of piedmontite in a boulder of San Onofre breccia near San Juan Capistrano Point.

Riverside County: Boulders and pebbles of quartz-piedmontite schist occur in sedimentary rocks on the south side of the Painted Hills about 3 miles north of Whitewater.

San Bernardino County: Quartz-piedmontite schist is found in a ravine entering Lytle Creek from the northeast just above the mouth of Coldwater Canyon.

San Diego County: Piedmontite has been found in a boulder of quartz porphyry from the gravels at Pacific Beach by Rogers (12).

ALLANITE—Orthite

Basic calcium, iron, aluminum, and cerium silicate, $(Ca,Fe)_2(AlOH)(Al,Ce,Fe)_2(SiO_4)_3$.

Monoclinic. Flat tabular crystals, also massive and in imbedded grains. Cleavage (100) and (001). Brittle. Pitchy luster. Color brownish-black. H. = 5½ — 6. G. = 3.5 — 4.2.

Fuses easily with intumescence to a dark slag. Soluble in hydrochloric acid, yielding gelatinous silica.

A minor constituent of granitic rocks.

Calaveras County: Allanite occurs in the Ford mine, half a mile east of San Andreas, Knopf (29).

Riverside County: It has been observed as a constituent of the gneiss of the Eagle Mountains.

San Diego County: It occurs in black masses in quartz veins northwest of Pala, and in large rough crystals in a pegmatite vein on the N. S. Weaver ranch 3 miles north of Pala.

Tulare County: Massive allanite occurs with rose quartz in a pegmatite on the Gasenberger ranch, near Exeter.

Tuolumne County: Allanite was found in talus blocks from a pegmatite at the foot of Eagle Peak in Yosemite Valley, Ries (01).

PUMPELLYITE

Hydrous calcium aluminum silicate, $Ca_4Al_5(Mg,Fe)Si_6O_{23}(OH)_3.2H_2O$.

Monoclinic. In minute fibers or narrow plates. Good (001) cleavage. Color green or brown. H. = 5½. G. = 3.2.

Sonoma County: Pumpellyite was reported from two localities by Irving, Vonsen and Gonyer (32). Dull-green pumpellyite occurs with lawsonite in veins in glaucophane schist at Mill Creek. Brown fibrous pumpellyite occurs in tufts or radiating aggregates in glaucophane scist near Skaggs. Analyses by Gonyer:

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO
Mill Creek	38.01	0.21	25.88	1.11	2.90	0.17	1.81	22.70
Skaggs	37.63	0.41	27.14	---	3.25	1.03	1.47	21.49

	Na_2O	K_2O	H_2O+	H_2O-		G
Mill Creek	0.46 (Na_2O + K_2O)		6.64	---	= 99.89%	3.18
Skaggs	0.46	0.08	7.27	0.12	= 100.35%	3.22

ZIRCON

Zirconium silicate, $ZrSiO_4$.

Tetragonal. In small prisms. Brittle. Adamantine luster. Colorless, yellowish, grayish, brown, pink. Streak uncolored. H. = 7½. G. = 4.68 — 4.70.

Infusible. A hydrochloric acid solution of zirconium turns turmeric paper an orange-red.

Zircon is a common accessory mineral in the acid eruptive rocks, especially granites and syenites. The concentrates from the gold washings and the black sands generally carry some zircon crystals.

Alameda County: Zircon was mentioned by Palache (93) as one of the constituents of the soda-rhyolite of North Berkeley.

Butte County: Zircon was first mentioned in this State by Silliman (73) as a constituent of the gold washings at Cherokee. It has

been observed in the sands at Oroville, Stirling City, Little Rock Creek, and Brush Creek.

Calaveras County: Zircon occurs in the sands at Douglas Flat and Wallace.

Del Norte County: It was found at Crescent City, Gilbert Creek, and Smith River.

El Dorado County: It occurs in the sands of the Brownsville district, near Placerville, and at Grizzly Flats.

Fresno County: It occurs in the sands at Picayune Flat.

Humboldt County: The beach sands at Gold Bluff and Upper Gold Bluff contain a little zircon. It was also found at Orleans and Trinidad.

Marin County: Zircon occurred in quartzite near Reed Station, Murgoci (06).

Mendocino County: It was observed at Fort Bragg, in Anderson Valley, and on the Novarro River.

Mono County: Minute rounded grains of zircon occur with andalusite in the mine of Champion Sillimanite, Incorporated, on the western slope of the White Mountains, 7 miles east of Mocalno, Woodhouse (36).

Nevada County: It was a constituent of the granodiorite of Nevada City, Lindgren (96). It was found in the concentrates at Nevada City, Grass Valley, and Rough and Ready.

Placer County: It was observed at Butcher Ranch and Gold Run. Zircon sand is being obtained (1937) in commercial quantities in the sluice boxes of the Kaufield dredge, 2 miles east of Lincoln.

Plumas County: It occurred in the Diadem lode, Meadow Valley, Turner (96). It was found in the sands at Spanish Ranch and Rock Island Hill. It was a constituent of the norites at Engels.

Riverside County: Minute clove-brown crystals of zircon showing the forms (100), (110), (111), and (331), are scattered through some of the white pegmatite dikes at Crestmore, Eakle (17). Zircon is a constituent of the igneous rocks of the Eagle Mountains. Zircon has been found in a pegmatite near Ramona, Patton (34).

Sacramento County: It is common in the sands at Michigan Bar.

San Diego County: It is a constituent of the dumortierite schist at Dehesa, Schaller (05).

San Luis Obispo County: The beach sands at Port San Luis and Pismo contain some zircon.

San Mateo County: The beach sands of the county show a little zircon.

Santa Barbara County: It occurs in the sands at Point Sal.

Santa Cruz County: It is found in the sands at Aptos.

Shasta County: Zircon occurs in the sands from French Gulch and Redding.

Siskiyou County: It occurs in the sands of Jackson Creek, Scott River, Salmon River, and at Sawyers Bar. Colorless and pale-pink crystals of zircon from near Fort Jones have the forms (100), (110), (101), (111), (311), and (511), Eakle (01).

Trinity County: It was found at Trinity Center, Burnt Ranch, Junction City, Minersville, and in the sands of the streams.

Yuba County: It occurs in the sands of Camptonville.

DATOLITE

Basic calcium borosilicate, $HCaBSiO_5$.

Monoclinic. In small prismatic and tabular crystals; massive. Brittle. Vitreous luster. Color white, grayish, greenish. Streak white. H. = 5 — 5½. G. = 2.9 — 3.0.

Fuses easily to a clear glass and colors flame bright-green. Gelatinizes with hydrochloric acid. Gives water in a closed tube.

Datolite forms veins of glassy crystals or white massive material in dikes and along the contact of igneous intrusions of diabase and diorite.

Inyo County: White massive datolite was found with idocrase and garnet at the San Carlos mine, and was analyzed by J. L. Smith (74).

SiO_2	B_2O_3	CaO	H_2O	
38.02	21.62	33.87	5.61 = 99.12%	G. = 2.988.

Riverside County: Massive white glassy datolite, with a slight greenish tinge, occurs with the pegmatite at Crestmore, Eakle (17).

San Francisco County: Glassy crystals and white veins of datolite occur in an altered diabase dike in the serpentine at Fort Point. Analyzed by Schaller. Forms: (001), (100), (110), (120), (011), (012), (102), (104), $(\bar{1}02)$, (111), $(\bar{1}11)$, $(\bar{1}12)$, $(\bar{1}13)$, $(\bar{1}14)$, $(\bar{1}16)$, (312), (121), $(\bar{2}31)$, and (1.1.18), Eakle (01).

SiO_2	Al_2O_3	B_2O_3	CaO	H_2O
36.71	0.17	22.11	33.83	6.52 = 99.34%

TOPAZ

Aluminum fluo-silicate, $Al_2(F,OH)_2SiO_4$.

Orthorhombic. Prismatic crystals. Also granular, coarse or fine. Cleavage perfect basal. Brittle. Vitreous luster. Color straw-yellow, wine-yellow, white, bluish, greenish. Streak uncolored. H. = 8. G. = 3.4 — 3.6.

Infusible. Ground with a few beads of phosphorous salt and heated in a bulb tube, will yield hydrofluoric acid which etches the glass and forms a white ring or coating of silicon fluoride. Moistened with cobalt nitrate and intensely heated, becomes sky-blue. Partially attacked by sulphuric acid.

Butte County: Topaz was mentioned by Silliman (73) as a constituent of the sands at Cherokee.

Fresno County: It is said to occur with beryl at the feldspar deposit, 5 miles northeast of Trimmer.

Mono County: A small amount of granular topaz occurs in andalusite at the mine of Champion Sillimanite, Incorporated, on the western slope of the White Mountains, 7 miles east of Mocalno, Kerr (32).

San Diego County: Fine large crystals of colorless and aquamarine topaz occurred at the Little Three and Sunrise mines, near Ramona. Some of them resemble topaz from the Urals. Fine crystals of topaz, light-green in color, occur in the Aguanga Mountains. Good bluish topaz resembling Ural topaz has been found at the Mountain Lily mine, near Oak Grove.

AXINITE

Aluminum and calcium borosilicate, with iron and manganese, $H(Ca,Mn,Fe)_3BAl_2(SiO_4)_4$.

Triclinic. Thin wedge-shaped crystals. Sometimes granular massive. Cleavage (010) distinct. Vitreous luster. Color clove-brown, yellow, plum-blue, violet, white. Streak uncolored. H. = 6½ — 7. G. = 3.27 — 3.29.

Fuses with swelling and intumescence, and may show slight greenish flame. Powder mixed with potassium bisulphate and fluorite, and held on platinum wire in the Bunsen flame, will give a momentary green flame of boron. Insoluble in acid.

Butte County: Transparent, plum-colored crystals of axinite were reported to be common in the gold placers at Yankee Hill.

El Dorado County: Small clove-brown crystals of axinite occurred deposited on epidote at the old Cosumnes copper mine near Fairplay. They have been described and analyzed by Schaller (11). Forms: $(1\bar{1}0)$, (010), $(1\bar{2}0)$, $(1\bar{3}0)$, $(1\bar{6}0)$, (1.29.0), (160), (270), (7.11.0), (110), (540), (430), (210), (310), (510), (100), $(3\bar{1}0)$, $(9\bar{5}0)$, $(13.\overline{15}.0)$, $(\bar{1}11)$, (111), and (201).

SiO_2	Al_2O_3	FeO	CaO	MnO	MgO	B_2O_3	H_2O
42.79	16.38	4.22	19.21	8.76	0.09	6.70	1.85 = 100.00%

Thin bladed masses of violet-colored axinite occur in veins on the northeast side of Lily Lake, near Glen Alpine.

Inyo County: Axinite was found in the Funeral Mountains and in the Owl Mountains, Death Valley. Perfectly formed small white

crystals of axinite with smithsonite occur at the Ubehebe mine. Axinite crystals were found in the Argus Range.

Mono County: Large plum-colored crystals of axinite are found in vugs and fissures of metamorphic rock at the southeast base of Mount Baldwin.

Placer County: Veins of axinite occur in metamorphic rock at the summit of the ridge just south of Five Lakes.

Riverside County: A large axinite crystal from the city quarry at Riverside, measured 9 by 12 by 1½ centimeters. Forms: $(1\bar{1}1)$, (111), $(1\bar{1}0)$, (201), (001), (110), and $(0\bar{1}0)$. The axinite of this quarry is violet-brown, Rogers (12). Violet axinite occurs with cinnamon garnet in the pegmatite at Crestmore, Eakle (17). Crystals of violet-colored axinite are found in the Box Springs Mountains.

San Diego County: Smoky-pink crystals of axinite with quartz, epidote, and laumontite occur in an altered granite in Moosa Canyon, about 18 miles south of Pala, near Bonsall; they have been described and analyzed by Schaller (11). Forms: $(1\bar{1}0)$, $(1\bar{3}0)$, (110), (100), $(\bar{3}31)$, $(1\bar{1}1)$, $(1\bar{1}2)$, (021), $(\bar{1}32)$, (201), (111), $(1\bar{3}1)$, and $(1\bar{3}2)$.

SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MnO	MgO	B_2O_3	H_2O
42.61	17.43	0.38	7.53	19.74	4.10	0.44	6.04	1.56 = 99.83%

ILVAITE

Calcium and iron silicate, $CaFe_2(FeOH)(SiO_4)_2$.

Orthorhombic. In long prisms vertically striated. Columnar or compact massive. Cleavage (010) and (001) distinct. Brittle. Submetallic luster. Color and streak grayish-black. H. = 5½ — 6. G. = 3.99 — 4.05.

Easily fusible. Becomes magnetic after heating. Gelatinizes with hydrochloric acid.

Shasta County: Thin bands and long prisms of ilvaite occur on both sides of a narrow dike cutting through limestone on Potter Creek, near Baird. The crystals occur on quartz and hedenbergite and have been described by Prescott (08). Forms: (110), (120), (010), (111), (101), and (890). Analyzed by H. R. Moss:

SiO_2	Fe_2O_3	Al_2O_3	Cr_2O_3	FeO	MnO	CaO	MgO	H_2O
28.09	20.80	0.32	0.13	29.93	3.24	15.89	0.18	1.62 = 100.20%

Sonoma County: A boulder of quartzite, colored black with ilvaite, was found near Petaluma.

ANDALUSITE

Aluminum silicate, Al_2SiO_5.

Orthorhombic. In coarse prismatic forms. Massive, columnar. Cleavage (110) distinct. Brittle. Vitreous luster. Colorless, gray, pink, rose-red, violet, green. Streak uncolored. H. = 7½. G. = 3.16 — 3.20.

Infusible. Moistened with cobalt nitrate and heated, yields the alumina blue color. Insoluble.

Andalusite occurs as a constituent of gneisses and schists, and is usually associated with kyanite, sillimanite, and staurolite.

Chiastolite is a variety found in carbonaceous schists, in knotty and long prismatic crystals having black inclusions of carbon arranged axially, thus forming black crosses seen in the transverse sections.

Fresno County: Chiastolite occurs near Chowchilla Crossing on the old Fort Miller road. Large crystals of andalusite occur with garnet, epidote, and apatite in a pegmatite in Clarks Valley, 9 miles east of Sanger, Melhase (35a). Andalusite has been found with quartz and albite about 1½ miles southeast of Sharpville, in the S½ Sec. 20, T. 11 S., R. 22 E., M. D. M.

Kern County: Chiastolite schists occur on Walkers Creek, southeast of Bakersfield.

Madera County: The belt of chiastolite schists in the foothills of the Sierra Nevada extends through this county. Crystals of andalusite occur in mica schist on the north Fork of San Joaquin River, half a mile below the junction with Bench Creek, Erwin (34).

Mariposa County: Chiastolite schists are abundant along the Chowchilla River, and were first reported by W. P. Blake (58). Chiastolite was mentioned by Turner (94a) from the Ne Plus Ultra mine near Barenda; from the Daulton ranch near Indian Gulch; and from Yaqui Gulch near Mariposa. Small crystals of andalusite occur in slate on the Muller ranch near Hornitos. Chiastolite is found on Moores Flat. Good chiastolite is reported from a point 4 miles southwest of Bridgeport.

Mono County: A large commercial deposit of andalusite, associated with corundum, quartz, pyrophyllite, and a great many other minerals, is worked at the mine of Champion Sillimanite, Incorporated, on the western slope of the White Mountains, 7 miles east of Mocalno. This occurrence has been described by Knopf (17a), Peck (24), Jeffery and Woodhouse (31), and Kerr (32).

Nevada County: Andalusite is a constituent of quartzite at Grass Valley, Lindgren (96).

Riverside County: Large crystals of pink andalusite are found near Coahuila, Kunz (05), Schaller (04a). Andalusite has been found in pegmatite dikes cutting the magnesite deposits near Winchester, Murdoch (36a).

Sacramento County: Boulders containing chiastolite crystals occur in the gravel bars of the American River, near Folsom.

San Diego County: Pink, radiating masses of andalusite occur in quartz veins northeast of Pala.

Tulare County: Crystals of andalusite up to 2 inches long occur in mica schist on the west side of the valley of Sheep Creek.

SILLIMANITE—Fibrolite

Aluminum silicate, Al_2SiO_5.

Orthorhombic. In long slender prisms. Fibrous and columnar massive forms. Cleavage perfect brachypinacoidal. Vitreous luster. Color grayish-brown, grayish-white, olive-green. Streak uncolored. H. = 6 — 7. G. = 3.23 — 3.24.

The reactions are identical to those for andalusite; the two minerals are generally differentiated by their dissimilar structure.

Sillimanite is a constituent of metamorphic gneiss and schist, often with kyanite, andalusite, and staurolite.

Inyo County: Random fibers of sillimanite are found in schist at the scheelite deposit in Deep Canyon, west of Bishop. Sillimanite occurs massive near Laws.

Los Angeles County: It occurs in schists in the San Rafael Hills, W. J. Miller (34). It was observed by Beverly (34) at the graphite deposits in San Francisquito, Kagel, and Elizabeth Lake Canyons, in the western part of the San Gabriel Mountains.

Mariposa County: It occurs in the schists near Mariposa, Turner (96), Fairbanks (90).

San Bernardino County: It occurs in schist at Ord Mountain, 15 miles southeast of Daggett.

San Diego County: It is a constituent of the dumortierite gneiss at Dehesa, Schaller (05).

Tuolumne County: Sillimanite from this county has been analyzed by H. N. Stokes, Clarke (15):

SiO_2	Al_2O_3	MgO
36.70	62.18	0.27 = 99.15%

KYANITE—Disthene

Aluminum silicate, Al_2SiO_5.

Triclinic. In long slender or blade-like crystals. Cleavage perfect macropinacoidal. Vitreous to pearly luster. Color blue, green, white, gray, black. Streak uncolored. H. = 5 — 7. G. = 3.56 — 3.67.

Infusible and insoluble. Like andalusite in its behavior before the blowpipe. It can be distinguished from andalusite and sillimanite by its physical properties.

Kyanite is a metamorphic mineral found in schists and gneisses with andalusite, sillimanite, and dumortierite.

Imperial County: Kyanite occurs with quartz, tourmaline, and pyrophyllite in the mine of the Vitrefrax Corporation, 3 miles northeast of Ogilby on the western slope of the Cargo Muchacho Range, Sampson and Tucker (31).

Tuolumne County: It is a constituent of the schists on Yankee Hill.

STAUROLITE

Iron aluminum silicate, $2FeO.5Al_2O_3.4SiO_2.H_2O$.

Orthorhombic. Crystals, often cross twins. Cleavage (010) distinct. Brittle. Sub-vitreous luster. Color yellow, brown, black. Streak uncolored. H. = 7 — 7½. G. = 3.65 — 3.77.

B. B. infusible. With the fluxes gives reactions for iron and manganese. Decomposed by sulphuric acid.

Staurolite occurs only in metamorphic rocks rich in aluminum.

Inyo County: Staurolite has been found in quartz-mica schist on the west side of the Panamint Range near Ballarat, Murphy (32).

SPHENE—Titanite

Calcium titano-silicate, $CaTiSiO_5$.

Monoclinic. In wedge-shaped and flattened crystals. Sometimes massive and compact. Cleavage (110) distinct. Adamantine luster. Color brown, yellow, gray, yellowish-green, black. Streak white. H. = 5 — 5½. G. = 3.4 — 3.56.

Fusible at about 3. Slightly soluble in hydrochloric acid, and the solution, when boiled down with metallic tin, assumes a violet color due to the titanium.

Sphene is a common accessory mineral of the granites, gneisses, and schists of the State. It has been mentioned by many writers in their petrographical descriptions as a miscroscopic constituent of the rocks.

Contra Costa County: Sphene is mentioned as an associate of crossite in the schists near San Pablo, by Palache (94a).

El Dorado County: Sphene was first observed by W. P. Blake (68) in the granite of Slippery Ford and other places of the Sierra Nevada.

Fresno County: Sphene is a constituent of the rocks at Fine Gold Gulch.

Inyo County: It occurs in microscopic crystals at the scheelite deposit of Deep Canyon, west of Bishop.

Kern County: Sphene occurs with garnet, quartz, and feldspar in a contact metamorphic limestone 200 yards east of Hobo Springs, near Havilah.

Marin County: It occurs as one of the minerals of the lawsonite schists of the Tiburon Peninsula, Ransome (95).

Mono County: Minute grains of sphene are scattered through the andalusite at the mine of Champion Sillimanite, Incorporated, on the western slope of the White Mountains, 7 miles east of Mocalno, Woodhouse, (36).

Riverside County: Granular sphene in pale-brown grains is abundant in the quartz monzonite at Crestmore, Eakle (17). Small crystals

of sphene occur in the igneous rocks of the Eagle Mountains. Sphene occurs as large yellow crystals with black tourmaline and quartz at a contact of granodiorite and quartzite in the West Riverside Hills.

San Diego County: Sphene is an associate of dumortierite at Dehesa, Schaller (05).

San Francisco County: It is a constituent of the rocks of San Francisco, Lawson (95).

Santa Clara County: Fine large crystals of sphene occur in the eclogites of Calaveras Valley; in the quartzite and diorite of Oak Hill, near San Jose; it is a common constituent of the glaucophane rocks of the Coastal region, Murgoci (06).

Sonoma County: Sphene is a conspicuous constituent of glaucophane schists near the mouth of the Russian River, Pabst (31).

Trinity County: It was found with epidote, colorless garnet, and zircon in a soda granite-porphyry in the Iron Mountain district, Weaverville quadrangle.

DUMORTIERITE

Basic aluminum borosilicate, $HAl_8BSi_3O_{20}$.

Orthorhombic. In small prisms. Massive, granular, fibrous. Cleavage (100) distinct. Vitreous luster. Color smalt-blue, dark-blue, violet-red. H. = 7. G. = 3.26 — 3.36.

Infusible and insoluble. Fused on platinum wire with a mixture of potassium bisulphate and fluorite will give a momentary green flame.

Imperial County: Dumortierite boulders occur over a wide area about 10 miles northeast of Ogilby, Wolff (30).

Riverside County: Massive dark-blue dumortierite occurs 1 mile north of the Big Four mines in the Pinacate district. Dumortierite has been found in quartz monzonite, a rock resembling granite, just west of the railroad trestle near the mouth of Temescal Wash, 2 miles southeast of Corona. Murphy (30) has reported the occurrence of dumortierite in granodiorite near the Cajalco tin mine, 13 miles southwest of Riverside.

San Diego County: Violet-red dumortierite occurs near Dehesa, and was described and analyzed by Schaller (05); also analyzed by Ford (02). Forms (010), (100), (110), (120), (320), (210), (102), and (203).

	SiO_2	Al_2O_3	Ti_2O_3	Fe_2O_3	B_2O_3	H_2O	
Schaller	28.68	63.31	1.45	0.23	5.37	1.52 = 100.56%	G. = 3.306.
Ford	30.58	61.83	---	0.36	5.93	2.14 = 100.84%	

THAUMASITE

Hydrous calcium silicate, carbonate, and sulphate, $CaSiO_3.CaCO_3.CaSO_4.15H_2O$.

Hexagonal. Masses of interlaced needles. Greasy luster. Colorless and white. H. = 3½. G. = 1.877.

Infusible, but swells up when heated, coloring the flame red. Easily soluble. Gives water in a closed tube.

Riverside County: Thaumasite occurred in needles with spurrite lining cavities in the limestsone at Crestmore. It was observed, described, and analyzed by Foshag (20):

SiO_2	$Al_2O_3.Fe_2O_3$	CaO	SO_3	$H_2O.CO_2$
9.10	0.84	12.98	27.56	49.48 = 99.96%

San Bernardino County: Thaumasite occurs in small veins cutting dolomite in the Dewey mine about 6 miles east of Valley Wells.

SPURRITE

Calcium carbonate and silicate, $CaCO_3.2Ca_2SiO_4$

Monoclinic. Granular masses. Cleavage (001) good. Color pale-gray to slightly bluish. H = 5. G. = 3.01.

Infusible. Gives calcium flame. Soluble in hydrochloric acid with some effervescence, and separation of silica.

Riverside County: Spurrite occurs intimately associated with merwinite and gehlenite in the limestone at Crestmore, Foshag (20).

TILLEYITE

Calcium carbonate and silicate, $CaCO_3.Ca_2SiO_4$.

Monoclinic. Color white. One perfect cleavage. G. = 2.838.
Effervesces and gelatinizes with acid.

San Bernardino County: Tilleyite was discovered in the contact zone at Crestmore, and named by Larsen and Dunham (33). Analysis by Gonyer:

SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	H_2O	CO_2
24.09	0.61	0.12	0.43	57.75	1.09	15.82 = 99.91%

GLOSSARY

Acicular.
Long and slender; needle-like.

Adamantine.
Like a diamond in luster.

Amorphous.
Without form; applied to rocks and minerals having no definite crystalline structure.

Amygdaloidal.
Relating to an amygdule.

Amygdule.
A small cavity in an eruptive rock caused by steam or vapor at the time of its eruption and generally lined or filled afterwards with secondary minerals

Arborescent.
Applied to minerals when assuming a tree-like form, especially when fairly massive; if so thin as to resemble the painting of a tree, they are generally termed dendrites.

Argillaceous.
Of or containing clay.

Bladed.
Flattened like a knife blade.

Botryoidal.
Having the form of a bunch of grapes, or consisting of a group of rounded prominences.

Breccia.
A coarse fragmental rock the components of which are angular, and therefore, as distinguished from conglomerates, are not water-worn.

Brecciated.
Converted into, or resembling, a breccia.

Brittle.
Easily broken.

Capillary.
Very slender and long, like a thread or hair.

Cellular.
Porous, like a sponge.

Cleavage.
Tendency to break in certain definite directions, yielding more or less smooth surfaces.

Colloidal.
A state of matter supposed to represent a degree of subdivision into almost molecular dimensions; jelly-like.

Conchoidal.
Shell-shaped. Minerals that break with concave and convex surfaces and are said to have a conchoidal fracture.

Concretion.
A spheroidal or discoidal aggregate formed by the segregation and precipitation of some mineral around a nucleus.

Conglomerate.
A consolidated rock composed of water-worn pebbles and boulders.

Coralloidal.
Like coral, or consisting of interlaced flexuous branchings.

Cryptocrystalline.
Crystalline, but so fine-grained that no individual crystals can be distinguished.

Decrepitation.
The breaking up with a crackling noise of mineral substances when exposed to heat, as when common salt is thrown upon the fire.

Deflagrate.
To burst into flame; to burn rapidly.

Dendritic.
Branching like a tree, as in crystallized gold.

Drusy.
Covered with minute crystals closely crowded.

Effervescence.
Bubbling due to the escape of gas.

Euhedral.
Bounded by its own crystal faces; said of some minerals in a crystalline rock, and contrasted with subhedral and anhedral.

Exfoliate.
To swell up and open into leaves or plates like a partly opened book.

Fibrous.
Made up of fibers as in asbestos.

Flexible.
Capable of being bent.

Fluorescence.
The emission of light from within a substance, while it is being exposed to direct radiation.

Foliated.
Composed of, or easily splitting into thin flakes or plates.

Friable.
Easy to break, or crumbling naturally.

Gangue.
Vein minerals of no particular commercial value, such as quartz, calcite, barite, fluorite, etc.

Gel.
A jelly-like or colloidal substance.

Geode.
A hollow nodule or concretion, the cavity of which is lined or completely filled with minerals, often well crystallized.

Globular.
Spherical or nearly so.

Gossan.
A ferruginous deposit filling the upper parts of mineral veins or forming a superficial cover on masses of pyrite. It consists principally of hydrated iron oxide, and results from oxidation.

Impalpable.
Not distinguishable by the naked eye.

Inclusion.
Any foreign body inclosed within a crystal.

Indurated.
Hardened; applied to rocks hardened by heat, pressure, or cementation.

Intumescence.
Swelling or bubbling up before the blowpipe.

Iridescence.
Exhibition of colors in the interior or on the surface of a mineral, caused by the presence of minute foreign crystals, in parallel positions, or by the presence of fine cleavage-lamellae.

Lamellar.
Composed of thin sheets or lamellae.

Lenticular.
Shaped approximately like a double convex lens. When a mass of rock thins out from the center to a thin edge all around, it is said to be lenticular in form.

Lithophysa.
A variety of spherulite consisting of concentric, roughly spherical or hemispherical shells with thin vacant spaces between them.

Malleable.
Capable of being extended or shaped by beating with a hammer.

Mammillary.
Like botryoidal, but composed of larger prominences.

Massive.
Without crystal form or faces.

Micaceous.
Composed of thin plates or scales, or, like mica, capable of being easily split into thin sheets.

Nodular.
In tuberose forms, or having irregular protuberances over the surface.

Oölitic.
Consisting of rounded particles the size of fish eggs.

Opalescence.
Milky or pearly reflection from the interior of a specimen.

Opaque.
Impervious to light.

Parting.
False cleavage, often the result of twinning.

Phosphorescence.
The continued emission of light by a substance after heating, exposure to light, or to an electrical discharge.

Pisolitic.
Composed of small, rounded masses, the size of peas.

Plumose.
Feather-like.

Prismatic.
Having elongation (of crystals) in one direction.

Pyroelectricity.
The simultaneous development of positive and negative charges of electricity on different parts of the same crystal when its temperature is suitably changed.

Radiated.
Formed of, or arranged like, rays or radii; having radial parts or markings; as a radiated structure.

Reniform.
Kidney-shaped, or having a surface like a kidney, composed of numerous slightly curved surfaces. The structure may be radiating or concentric.

Reticulated.
Having slender crystals or fibers crossing like the meshes of a net.

Sectile.
Capable of being cut with a knife, but still pulverizing under hammer.

Solfatara.
An expiring or dormant volcanic vent from which steam and vapors are emitted.

Specific gravity.
The ratio of the weight of a substance to the weight of an equal volume of water. The specific gravity is designated by G. in the mineral descriptions.

Spherulites.
Aggregates spherical in form and radiated or concentric in structure.

Stalactitic.
Having the form of a stalactite or an icicle.

Stellated.
Resembling a star; pointed or radiated like a star.

Striated.
Marked with parallel grooves or striae.

Terminations.
Faces on the end of a crystal.

Translucent.
A body is translucent if it transmits light without permitting objects to be seen through it.

Transparent.
A body is transparent if it transmits light so that objects can be seen through it.

Triboluminescent.
Becoming luminescent when rubbed or scratched.

Twin.
A symmetrical combination or intergrowth of two crystals.

Vesicle.
A small cavity in fine-grained or glassy igneous rock, formed by the expansion of a bubble of gas or steam during the solidification of the rock.

Vesicular.
Characteristic of or characterized by, pertaining to, or containing vesicles.

Vug.
A cavity in rock, usually lined with a crystalline incrustation.

Widmanstätten figures.
Figures developed on a cut and polished surface of meteoric iron by etching with acid.

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Carnegie Inst Wash, Pub. Carnegie Institution, Washington (D. C.), Publications.
Centralbl Miner. Centralblatt für Mineralogie, Geologie, und Paläontologie. Stuttgart.
Ch News. Chemical News, London.
Colo Sc Soc, Pr. Colorado Scientific Society, Proceedings.
Ec G. Economic Geology.
Eng M J. Engineering and Mining Journal.
G Mag. Geological Magazine. London.
G Soc Am, B, Pr. Geological Society of America, Bulletin, Proceedings.
Int G Cong. International Geological Congress.
J G. Journal of Geology.
Journ f. prakt Chem. Journal für praktische Chemie.
K-k Reichsanstalt, Verh. Kaiserlich-königliche geologische Reichsanstalt, Verhandlungen. Wien.
K-k Naturh Hofmus, An. Annalen des Kaiserlich-königlichen Naturhistorischen Hofmuseums. Wien.
Lyc N H, N Y, Pr. Lyceum of Natural History of New York, Proceedings. Later: New York Academy of Sciences.
M Cong J. Mining Congress Journal.
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During the past fifty-six years, in carrying out the provisions of the organic act creating the former California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the State, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have usually been limited, the reports and bulletins mentioned are printed in limited editions many of which are now entirely exhausted.

Copies of such publications are available for reference, however, in the offices of the Division of Mines, in the Ferry Building, San Francisco; State Building, Los Angeles; State Office Building, Sacramento; Redding; and Division of Oil and Gas at Santa Barbara, Taft, Bakersfield, Coalinga. They may also be found in many public, private and technical libraries in California and other states and foreign countries.

A catalog of all publications from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained postpaid by addressing any of the above offices and enclosing the requisite amount in the case of publications that have a list price. Only coin, stamps or money orders should be sent, and it will be appreciated if remittance is made in this manner rather than by personal check.

Money orders should be made payable to the Division of Mines.

NOTE.—The Division of Mines frequently receives requests for some of the early Reports and Bulletins now out of print, and it will be appreciated if parties having such publications and wishing to dispose of them will advise this office.

REPORTS

Asterisks (**) indicate the publication is out of print.

	Price Postpaid
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks	----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks	----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks	----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks	----
Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks	$0.70
Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.	.70
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.	----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.	----
Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.	---- 1.15
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Irelan, Jr.	----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.	1.25
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford	----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford	----
Chapters of the State Mineralogist's Report, Biennial Period, 1913-1914, Fletcher Hamilton:	
Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper	.60
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper	.60
Mines and Mineral Resources, Del Norte, Humboldt and Mendocino Counties, 59 pp., paper	.35
**Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pp., paper	----
Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper	.50
Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper	.60
Fourteenth Report of the State Mineralogist, for the Biennial Period 1913-1914, Fletcher Hamilton, 1915:	
A General report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou and Trinity Counties, 974 pp., 275 illustrations, cloth	3.00
Chapters of the State Mineralogist's Report, Biennial Period, 1915-1916. Fletcher Hamilton:	
Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper	.75
Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter and Tehama Counties, 91 pp., paper	.55
Mines and Mineral Resources, El Dorado, Placer, Sacramento and Yuba Counties, 198 pp., paper	.75

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	Price Postpaid
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara and Ventura Counties, 183 pp., paper	$0.75
Mines and Mineral Resources, Los Angeles, Orange and Riverside Counties, 136 pp., paper	.60
Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper	.75
**Fifteenth Report of the State Mineralogist, for the Biennial Period 1915-1916, Fletcher Hamilton, 1917:	
A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth	----
Chapters of the State Mineralogist's Report, Biennial Period, 1917-1918, Fletcher Hamilton:	
Mines and Mineral Resources of Nevada County, 270 pp., paper	.90
Mines and Mineral Resources of Plumas County, 188 pp., paper	.60
Mines and Mineral Resources of Sierra County, 144 pp., paper	.60
Seventeenth Report of the State Mineralogist, 1920, 'Mining in California during 1920,' Fletcher Hamilton; 562 pp., 71 illustrations, cloth	2.00
Eighteenth Report of the State Mineralogist, 1922, 'Mining in California,' Fletcher Hamilton. Chapters published monthly beginning with January, 1922:	
**January, **February, March, April, **May, June, July, August, September, October, November, December, 1922	.30
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923	.30
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, July, October, 1924, per copy	.30
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
January, 1925, Mines and Mineral Resources of Sacramento, Monterey and Orange Counties	.30
April, 1925, Mines and Mineral Resources of Calaveras, Merced, San Joaquin, Stanislaus and Ventura Counties	.30
July, 1925, Mines and Mineral Resources of Del Norte, Humboldt and San Diego Counties	.30
October, 1925, Mines and Mineral Resources of Siskiyou, San Luis Obispo and Santa Barbara Counties	.30
Chapters of Twenty-second Report of the State Mineralogist, 'Mining in California', Lloyd L. Root. Published quarterly:	
January, 1926, Mines and Mineral Resources of Trinity and Santa Cruz Counties	.30
April, 1926, Mines and Mineral Resources of Shasta, San Benito and Imperial Counties	.35
July, 1926, Mines and Mineral Resources of Marin and Sonoma Counties	.30
**October, 1926, Mines and Mineral Resources of El Dorado and Inyo Counties, also report on Minaret District, Madera County	----
Chapters of Twenty-third Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
January, 1927, Mines and Mineral Resources of Contra Costa County; Santa Catalina Island	.35
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**July, 1927, Mines and Mineral Resources of Placer and Los Angeles Counties	----
October, 1927, Mines and Mineral Resources of Mono County	.30
Chapters of Twenty-fourth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
January, 1928, Mines and Mineral Resources of Tuolumne County	.30

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Chapters of Twenty-fifth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:	
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July, 1929, Mines and Mineral Resources of Colusa, Fresno and Lake Counties	.35
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Chapters of Twenty-seventh Report of the State Mineralogist, 'Mining in California,' Walter W. Bradlley. Published quarterly:	
January, 1931, Preliminary Report of Economic Geology of the Shasta Quadrangle. Beryllium and Beryl. The New Tariff and Nonmetallic Products. Crystalline Talc. Decorative Effects in Concrete	.35
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**July, 1931. (Yuba, San Bernardino.) Feldspar, Silica, Andalusite and Cyanite Deposits of California. Note on a Deposit of Andalusite in Mono County; its occurrence and chemical importance. Bill creating Trinity and Klamath River Fish and Game District and its effect upon mining	----
October, 1931. (Alpine.) Geology of the San Jacinto Quadrangle south of San Gorgonio Pass, California. Notes on Mining Activities in Inyo and Mono Counties in July, 1931	.30
Chapters of Twenty-eighth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:	
January, 1932, Economic Mineral Deposits of the San Jacinto Quadrangle. Geology and Physical Properties of Building Stone from Carmel Valley. Contributions to the Study of Sediments. Sediments of Monterey Bay. Sanbornite	.35
April, 1932. Elementary Placer Mining Methods and Gold Saving Devices. The Pan, Rocker and Sluice Box. Prospecting for Vein Deposits. Bibliography of Placer Mining	.35
Abstract from April quarterly: Elementary Placer Mining Methods and Gold Saving Devices. Types of Deposits, Simple Equipment. Special Machines. Dry Washing. Black Sand Treatment. Marketing of Products. Placer Mining Areas. Laws. Prospecting for Quartz Veins. Bibliography (mimeographed)	.25
July-October. (Ventura.) Report accompanying Geologic Map of Northern Sierra Nevada. Fossil Plants in Auriferous Gravels of the Sierra Nevada. Glacial and Associated Stream Deposits of the Sierra Nevada. Jurassic and Cretaceous Divisions in the Knoxville-Shasta Succession of California. Geology of a Part of the Panamint Range. Economic Report of a Part of the Panamint Range. Acquiring Mining Claims Through Tax Title. The Biennial Report of State Mineralogist	.65

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January-April. Gold Deposits of the Redding and Weaverville Quadrangles. Geologic Formations of the Redding-Weaverville District, Northern California. Geology of Portions of Del Norte and Siskiyou Counties. Applications of Geology to Civil Engineering. The Lakes of California. Discovery of Piedmontite in the Sierra Nevada. Tracing 'Buried River' Channel Deposits by Geomagnetic Methods. Geologic Map of Redding-Weaverville District, showing gold mines and prospects. Geologic Map showing various mines and prospects of part of Del Norte and Siskiyou Counties	$0.90
July-October. Gold Resources of Kern County. Limestone Deposits of the San Francisco Region. Limestone Weathering and Plant Associations of the San Francisco Region. Booming. Death Valley National Monument, California. Placer Mining Districts, Senate Bill 480. Navigable Waters, Assembly Bill 1543	.90
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April. Mineral Resources of Plumas County (with Geologic Map). List of preferred mineral names. New Placer Mining Debris Law	.50
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Bulletin No. 4. Catalogue of California Fossils, by J. G. Cooper, 1894, 73 pp., 67 illustrations. (Part I was published in the Seventh Annual Report of the State Mineralogist, 1887)	$0.10
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**Bulletin No. 6. California Gold Mill Practices, 1895, by E. B. Preston, 85 pp., 46 illustrations	----
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**Bulletin No. 8. Mineral Production of California, by Counties, for the year 1895, by Charles G. Yale. Tabulated sheet	----
Bulletin No. 9. Mine Drainage, Pumps, etc., by Hans C. Behr. 1896, 210 pp., 206 illustrations	.75
Bulletin No. 10. A Bibliography Relating to the Geology, Paleontology and Mineral Resources of California, by Anthony W. Vogdes. 1896, 121 pp.	.50
**Bulletin No. 11. Oil and Gas Yielding Formations of Los Angeles, Ventura and Santa Barbara Counties, by W. L. Watts. 1897, 94 pp., 6 maps, 31 illustrations	----
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**Bulletin No. 16. The Genesis of Petroleum and Asphaltum in California, by A. S. Cooper. 1899, 39 pp., 29 illustrations	----
**Bulletin No. 17. Mineral Production of California, by Counties, for 1899, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 18. Mother Lode Region of California, by W. H. Storms, 1900, 154 pp., 49 illustrations	----
**Bulletin No. 19. Oil and Gas Yielding Formations of California, by W. L. Watts. 1900, 236 pp., 60 illustrations, 8 maps	----
**Bulletin No. 20. Synopsis of General Report of State Mining Bureau, by W. L. Watts. 1901, 21 pp. This bulletin contains a brief statement of the progress of the mineral industry in California for the four years ending December, 1899	----
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**Bulletin No. 27. The Quicksilver Resources of California, by William Forstner. 1903, 273 pp., 144 illustrations, 8 maps	----

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**Bulletin No. 46. General Index of Publications of the California State Mining Bureau, by Charles G. Yale. 1907, 54 pp.	----
**Bulletin No. 47. Mineral Production of California, by Counties, 1906, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 48. Mineral Production of California for Twenty Years, by Charles G. Yale. 1906	----
**Bulletin No. 49. Mines and Minerals of California for 1906, by Charles G. Yale. 34 pp.	----
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Bulletin No. 71. Mineral Production for 1915, with County Maps and Mining Laws, by Walter W. Bradley, 193 pp. 4 illustrations	.25
**Bulletin No. 72. The Geologic Formations of California, by James Perrin Smith. 1916, 47 pp.	----
**Reconnaissance Geologic Map (of which Bulletin 72 is explanatory), in 23 colors. Scale: 1 inch = 12 miles. Mounted	----
**Bulletin No. 73. First Annual Report of the State Oil and Gas Supervisor of California for the fiscal year 1915-16, by R. P. McLaughlin. 278 pp., 26 illustrations	----
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**Bulletin No. 75. United States and California Mining Laws. 1917, 115 pp., paper	----
Bulletin No. 76. Manganese and Chromium in California, by Walter W. Bradley, Emile Huguenin, C. A. Logan, W. B. Tucker and C. A. Waring. 1918, 248 pp., 51 illustrations, 5 maps, paper	.60
Bulletin No. 77. Catalogue of Publications of California State Mining Bureau, 1880-1917, by E. S. Boalich. 44 pp., paper	Free
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PRELIMINARY REPORTS

**Preliminary Report No. 1. Notes on Damage by Water in California Oil Fields, December, 1913. By R. P. McLaughlin, 4 pp	----
**Preliminary Report No. 2. Notes on Damage by Water in California Oil Fields, March, 1914. By R. P. McLaughlin, 4 pp.	----
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**Preliminary Report No. 5. Antimony, Graphite, Nickel, Potash, Strontium and Tin. By E. S. Boalich and W. O. Castello, 1918. 44 pp. Paper	----
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**Preliminary Report No. 7. The Clay Industry in California. By E. S. Boalich, W. O. Castello, E. Huguenin, C. A. Logan, and W. B. Tucker, 1920. 102 pp. 24 illustrations. Paper	----
**Preliminary Report No. 8. A Review of Mining in California During 1921, with Notes on the Outlook for 1922. By Fletcher Hamilton, 1922. 68 pp. Paper	----

MISCELLANEOUS PUBLICATIONS

**First Annual Catalogue of the State Museum of California, being the collection made by the State Mining Bureau during the year ending April 16, 1881. 350 pp.	----
**Catalogue of books, maps, lithographs, photographs, etc., in the library of the State Mining Bureau at San Francisco, May 15, 1884. 19 pp.	----
**Catalogue of the State Museum of California, Volume II, being the collection made by the State Mining Bureau from April 16, 1881, to May 5, 1884. 220 pp.	----
**Catalogue of the State Museum of California, Volume III, being the collection made by the State Mining Bureau from May 15, 1884, to March 31, 1887. 195 pp.	----
**Catalogue of the State Museum of California, Volume IV, being the collection made by the State Mining Bureau from March 30, 1887, to August 20, 1890. 261 pp.	----
**Catalogue of the Library of the California State Mining Bureau, September 1, 1892. 149 pp.	----
**Catalogue of West North American and Many Foreign Shells with Their Geographical Ranges, by J. G. Cooper. Printed for the State Mining Bureau, April, 1894	----
**Report of the Board of Trustees for the four years ending September, 1900. 15 pp. Paper	----
Bulletin. Reconnaisance of the Colorado Desert Mining District. By Stephen Bowers, 1901. 19 pp. 2 illustrations. Paper	.10
Commercial Mineral Notes. A monthly mimeographed sheet, beginning April, 1923 (15c annually)	Free

MAPS

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**Register of Mines, with Map, Calaveras County	----
**Register of Mines, with Map, El Dorado County	----

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**Register of Mines, with Map, Shasta County	----
**Register of Mines, with Map, Sierra County	----
**Register of Mines, with Map, Siskiyou County	----
**Register of Mines, with Map, Trinity County	----
**Register of Mines, with Map, Tuolumne County	----
Register of Mines, with Map, Yuba County (1905)	.30
Register of Oil Wells, with Map, Los Angeles City (1906)	.10

OTHER MAPS

**Map of California, Showing Mineral Deposits (50x60 in.)	----
**Map of Forest Reserves in California	----
**Mineral and Relief Map of California	----
**Map of El Dorado County, Showing Boundaries, National Forests	----
**Map of Madera County, Showing Boundaries, National Forests	----
**Map of Placer County, Showing Boundaries, National Fortsts	----
**Map of Shasta County, Showing Boundaries, National Forests	----
**Map of Sierra County, Showing Boundaries, National Forests	----
**Map of Siskiyou County, Showing Boundaries, National Forests	----
**Map of Tuolumne County, Showing Boundaries, National Forests	----
**Map of Mother Lode Region	----
**Map of Desert Region of Southern California	----
Map of Minaret District, Madera County	.25
Map of Copper Deposits in California	.05
**Map of Calaveras County	----
**Map of Plumas County	----
**Map of Trinity County	----
**Map of Tuolumne County	----
**Geographical Map of Inyo County. Scale 1 inch equals 4 miles	----
**Map of California accompanying Bulletin No. 89, showing generalized classification of land with regard to oil possibilities. Map only, without Bulletin	----
Geological Map of California, 1916. Scale 1 inch equals 12 miles. As accurate and up-to-date as available data will permit as regards topography and geography. Shows railroads, highways, post offices and other towns. First geological map that has been available since 1892, and shows geology of entire state as no other map does. Geological details lithographed in 23 colors. Mounted	2.75
**Topographic Map of Sierra Nevada Gold Belt, showing distribution of auriferous gravels, accompanying Bulletin No. 92. In 4 colors (also sold singly)	----
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OIL FIELD MAPS

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Samples (limited to two at one time) of any mineral found in the State may be sent to the Division of Mines for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the State. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.